No. 2

MEMOIRS

OF THE

KYANCUTTA MUSEUM

Kyancutta, South Australia.

Further Notes on

Archaeocyathi (Cyathospongia)

and other organisms

From the LOWER CAMBRIAN of Beltana, South Australia

By

R. and W. R. Bedford

APRIL ——— 1936

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NOTE:—This paper deals with Archaeocyathi other than the main families, Archaeocyathidae and Coscinocyathidae, on which a separate paper is in preparation and will be issued shortly.

BIBLIOGRAPHICAL NOTE.

Since the publication of our former paper a valuable contribution to the classification of the group has been made by Dr. V. J. Okulitch (Trans. Royal Soc. of Canada, 1935).

Dr. Okulitch makes a new class—Cyathospongia—of the Porifera for these organisms, and divides the Class into Six Orders, *Archaeocyathina, Monocyathina, Acanthinocyathina, Heterocyathina, Anthomorphina,* and *Syringocnemina.* At the time we received Dr. Okulitch's paper we had reached very similar conclusions and were intending to divide the *Porifera* into a Sub-Phylum *Spongiae* and a Sub-Phylum (and Class) *Archaeocyathi.*

We suggest that, until the new name becomes familiarised, the Class be referred to as *Archaeocyathi (Cyathospongia).* As a vernacular name we are in the habit of referring to the fossils as Archaeos. In our present paper we propose to form two new Orders, *Spirocyathina* and *Metacyathina; Syringocnema,* instead of forming a separate Order, is regarded as related to the Spirocyathidae.

Two important papers, with copious illustrations of the Archaeos of Siberia and descriptions of interesting new genera, were published respectively in 1931 and 1932 by Dr. A. G. Vologdin of the Russian Geological Survey. We have only recently seen these papers, and Dr. Okulitch does not refer to them. Time and space will not permit us at present to attempt an adequate correlation between the South Australian and Siberian specimens.

Our present paper is of the nature of a "progress report"; it marks the complete working over of our first batch of material, which has occupied about three years of laboratory work, publication of results as regards the families *Archaeocyathidae* and *Coscinocyathidae* being deferred temporarily. There remains, however, an equal amount of work to be done on fresh material which we have in hand, from which we confidently expect important results in amplifying and supplementing the present and previous work.

The present paper describes and figures 22 new species, 6 new genera and 5 new families of Archaeos, besides giving fresh information and figures of some of the forms previously described by Taylor and ourselves. Two new orders are distinguished.

Unless otherwise stated, the specimens herein described are from the Lower Cambrian limestone of the Ajax Mine, Beltana, S. Australia.

The type specimens of all species described in our previous memoir have been acquired by the British Museum (Natural History). We have to thank that Museum and the Geological Departments of the Universities of Melbourne, Glasgow, Oxford, and Princeton, and the Smithsonian Institution and Sydney Museum for assistance given us by purchase and exchange of specimens, which has been of considerable help towards the expense of collecting and preparing material.

CALCAREOUS ALGAE.

New Genus. *Ajacia.*

Encrusting, laminated masses. The outer surface is fairly smooth and well-defined and shows a variety of mamillated masses between which are deep sulci. Two or three laminae, averaging 1 to 2 mm. in thickness, are usually present and follow the surface contours.

Genotype: *Ajacia Ajax.*

Ajacia Ajax, N. Sp. Plate VII., Fig. 37.

This fossil consists of densely silicified, mamillated, laminated masses shown at BBB. The apices of several Archaeocyathus cups are seen imbedded in these masses at AAA, and a broken fragment of a flattened, expanded Archaeocyathus occurs at D, within the laminae of the Alga. The unsilicified limestone matrix is shown in the figure by cross hatching, and the scribbled shading represents broken silicified masses which are in part fractured sections of the supposed Alga. The top of the figure (at C) no doubt corresponds to the top of the specimen in its natural position, as Archaeo cups are also embedded in the back surface of the specimen; the horizontal band of limestone crossing the lower part of the figure would thus correspond to a plane of bedding. The white or lightly shaded areas BBB are the natural mamillated surfaces of the Alga; a sharply re-entrant dimple is seen at C. In several places on the fractured surfaces the fossil can be seen to consist of two or three laminae which follow the surface contours. The specimen is too coarsely silicified to show any fine structure.

The specimen is a naturally weathered fragment found on the surface of the ground at the Ajax Mine, and, though careful search was made, no other examples could be found.

The fossil is interesting as showing an extraneous means of support for delicate Archaeo cups, and helps to explain the common absence of root tissues in the Ajax specimens.

New Genus. *Beltania.*

Dense limestone masses having a characteristic fracture like that of kidney-iron-ore, and an ivory-like grain, the latter being due to a multitude of fine threads in parallel orientation aggregated in wavy plates about ½ to 1 mm. apart. Genotype:*Beltania Beltana.*

Beltania Beltana, N. Sp. Plate VII., Fig. 38.

It was noticed, in handling the good fossiliferous material from the Ajax, that whereas some specimens are tough and resistant to crushing, others fracture readily and these latter often show a very characteristic natural fracture which has somewhat the appearance of the mamillated fracture of kidney-iron-ore. A shows this characteristic fracture at the upper part of the sketch, the lower cross-hatched part representing the normal, unorientated fracture of the limestone. On slicing and polishing the material with the characteristic fracture it shows a grain like that of ivory, and under low magnification this is seen to be due to a multitude of fine threads, dull white in color and with a parallel orientation, shown in sketch B. Another surface of the same specimen, polished on a different plane, give the appearances of sketch C.

One specimen, not that figured, has rather a striking appearance. The mass of *Beltania* is a band over 2 inches thick, pale in color, with the characteristic ivory grain; the remainder of the matrix is a black limestone full of Archaeo fragments; the two meet in an irregular wavy surface.

Beltania probably forms a very considerable percentage of the bulk of the Ajax limestone. Although Archaeos are generally considered to be calcareous, this cannot be regarded as certain; should they prove to be siliceous, the calcareous reef-matrix might be of algal origin.

Professor W. J. Sollas, in a recent letter, says: "If they (the Archaeocyathi) were siliceous I should put them down without hesitation as Hexactinellida."

SPONGES.

Uranosphaera hexaster (see Part 1, p. 7, Fig. 36.)

Fig 39 shows a somewhat similar Sponge. The specimen, which, like those previously described, is fragmentary, is one-half of a sphere 12 mm. diameter. It appears to be invaginated at the point marked by an arrow, giving a gastrula-like form. Welded to the outside rim of the "blastopore" is an excellently defined fragment of a six-rayed spicule. This is not seen in Fig A; it occurs just behind the arrow, and is shown in Fig. B. Fig. C shows one of the small flat six-rayed spicules on the outer surface of the sphere. Fig. D shows a very small spicule, apparently of many-rayed type, from the inner invaginated sphere; the longest ray projects inwards into the cavity. This spicule can just be seen in Fig. A; to the right of it is a similar spicule with the longest ray pointing obliquely outwards.

Fig. 40 shows a similar Sponge, the fragment being half of an ovoid. This has a small invaginated lip (see A and C), in which are seen sections of small spicular rays, but these are not so prominent or well defined as those in the other specimen. As before, small six-rayed spicules occur in the outer surface of the ovoid.

The group of spicules shown in Fig. 41 occurs in connection with a curved, ill-defined layer of poor silicification in which are several unsilicified "ghosts" of many-rayed spicules. One of these "ghosts" is seen at c. The many-rayed spicules shown at a and b are very close to the layer of "ghosts" and those ends of the rays which are still buried in the matrix would reach down to that layer. The "ghost" spicules rather resemble those of the small-spiculed sponge referred to on p. 7 after *Uranosphaera polyaster.*

GROUP OF LARGE SPONGE SPICULES.

Fig 42 shows two views of a piece of limestone which includes numerous fragments of large spicules. The greater number of these fragments lie in a circle (see left-hand figure); but whether this arrangement is

accidental or otherwise is doubtful; certainly there is no such evidence of organic union as is found in the case of Uranosphaera. The two most striking spicules have a *spread* of about 20 mm.; each has six rays, which are not arranged in a flat plane, but slope uniformly downwards at about 30 degrees from horizontal. These two spicules are shown at D and E, the latter being the more symmetrical of the two. In the downward slope of the rays these spicules agree with those of *Uranosphaera*, particularly the many-rayed forms of *Uranosphaera polyaster;* they are much larger than any of the ordinary six-rayed- wall-spicules seen so far in *Uranosphaera hexaster.*

VARIOUS ISOLATED SPONGE SPICULES.

A number of these are illustrated in Fig 43. A is the largest yet found at the Ajax. The ray to the right is 22 mm. long; the only other ray visible is the fragmentary one to the left. B has a long ray of 12 mm. planted on a base of short curved rays, but insufficient of these latter remain to determine their original number. C shows one ray of 11 mm. with a slight sigmoidal curvature, also the fragmentary bases of at least four other rays; although too imperfect for complete determination, the spicule might perhaps have had six uniform sigmoidal rays sloping downwards. D is a fine example of a symmetrical six-ray spicule with straight rays sloped uniformly downwards; two views are shown of this spicule. One or two other six-rayed spicules have been found in which the rays have less slope, half way between that figured and a plane surface. E is a delicate spicule with one long ray to which are attached short arms (probably four in the form of a cross), and another short arm proceeds from the point of junction nearly but not quite in the line of the long arm. FGH are three many-rayed spicules; it is, of course, impossible to say whether the rays were originally distributed in all directions of space or only over approximately a hemisphere. J is a pretty little spicule of unusual type, only the one specimen having been found; it has (or rather had) ten uniform rays, the lower surface being nearly plane, the upper bossed upwards in the centre; there is a possibility that a central ray may have proceeded upwards from the boss, as there is a small circle of fracture at this point.

Dr. R. J. Tillyard, who has seen some of the spicules and our sketches, writes: "I have been very interested in your sponge spicule problem and have had quite a lot of discussion with sponge experts on your fossils. At the beginning, they were all suspicious of them and considered them to be pseudo-spicules . . . but we finally put the problem into the hands of the most expert authority on sponges that we know of, viz., Mr. E. F. Hallmann, B.Sc., who used to be a Linnean Macleay Fellow and worked on sponges. He also was doubtful at first, but has now written to me to say that he agress with you that they are actually sponge spicules, though very remarkable ones."

Class *ARCHAEOCYATHI (CYATHOSPONGIA).*

Order *ACANTHINOCYATHINA* (Okulitch).

Family *ACANTHINOCYATHIDAE* (Bedford).

Acanthinocyathus Apertus (Bedford). (See Part 1, p. 4, Fig. 20.)

Specimen with Sponge Spicules in Intervallum.

This fragmentary specimen is shown in Fig. 44. One side of the main of the two fragments, A, shows the outer wall, which is irregularly thickened and obscured by secondary silicification. In contact with the outside of the wall is a large six-rayed spicule two rays of which have disappeared (probably at the commencement of work on the specimen). In order to preserve the remains of this spicule part of the matrix outside the wall was retained ;this part is shown by cross-hatching in the sketch. The upper part of this sketch shows a surface which cuts obliquely across the intervallum (b) and central cavity (a). The sketch B shows the reverse side of the same fragment; silicified organisms are shown white, limestone matrix black. The oval space in the middle is the central cavity. After this sketch was made more of the matrix was carved away (D) and etched so as to expose the inner surface of the network of the inner wall (a); the connecting bars between outer and inner wall are also well seen (b). The rod-like elements of the inner wall are studded with numerous tubercles, a feature which had not before been noticed.

In the intervallum are numerous and varied sponge spicules; none of of these are exposed within the central cavity. C shows another small fragment of the same specimen, the outer wall being here exposed from its inner surface.

Sketch E shows a number of the sponge spicules from the intervallum of the specimen; they are drawn as exposed and allowance must be made for parts which have been lost and for parts which are still buried in the matrix.

a. Insufficient remains to determine number of rays. b. Apparently four rays in one convex surface and another ray perpendicular. c, e, f. Multiradiate. d. Perhaps six rays in one convex surface but insufficient to be sure. g. Apparently four (possibly five) rays in one plane and a ray of considerable length perpendicular. h. Six rays in one plane (if another ray perpendicular to these, it is not exposed. j. Only two rays exposed, which suggest a spicule of six rays in one plane.

Are these spicules intergral parts of the fossil? or are they there by accident? In favor of the former alternative we have seldom found sponge spicules within the intervallum or central cavity of other Archaeos; also the fact that in this specimen the spicules appear confined to the intervallum and none in the central cavity, which

would be an easier place (one would think) for accidental fragments to accumulate in. Another point is that on carefully re-examining the seven specimens of *Acanthinocyathus* available two more of them are each seen to have one or two spicules within the intervallum. In our first paper we had commented on the spicule-like nature of the tissues of *Acanthinocyathus;* can it be only coincidence that actual spicules are now found within this organism?

Another question that naturally suggests itself is that of a possible relationship between *Acanthinocyathus,* the large sponge spicules, and *Uranosphaera.*

Another Fragment Comparable to Acanthinocyathus.

This is figured in Plate X. Fig. 45. A shows a transverse section; B a tangential view grazing the outer wall. To the left of a the outer wall rods dip inwards slightly and tubercles are visible similar to those noted on the inner wall of the previous specimen. At b the outer wall is lost and three of the connecting rods are seen in section in the intervallum.

Order *MONOCYATHINA* (Okulitch).

Family *MONOCYATHIDAE* (Bedford).

Monocyathus porosus (Bedford).

Some additional particulars of this species are figured in Plate X., Fig. 46.

A shows a reconstruction (natural size) of a large specimen which is much corrugated at the top. B shows the top of the specimen with incurved rim referred to on p. 2 of our 1934 memoir. C shows an inner view of the wall with vertical ridges between the rows of pores; the appearance is very similar to the walls of *Dokidocyathus,* but in that species the ridges in both walls are on the external surfaces of the walls.

Monocyathus robustus, N.Sp. Plate X., Fig. 47.

Tubular, 4 mm. diameter; wall nearly I mm. thick; Pores numerous, oval or circular, regularly arranged, about 1 mm. apart.

Monocyathus sparsipora, N.Sp. Plate X., Fig. 48.

Similar to *M. porosus,* but pores about 1 mm. apart.

Monocyathus mellifer, N.Sp. Plate X., Fig. 49.

Tubular, 4 mm. diameter; wall nearly 1 mm. thick; pores hexagonal, about 2/3 mm. apart, closely set in a regular honey-comb pattern, outer surface vertically ridged between the rows of pores.

Monocyathus spinosus, N.Sp. Plate X., Fig. 50.

Conical; pores large, more or less hexagonal about 1½ mm. apart; numerous spines, nearly 1 mm. long, project outwards.

Order *ARCHAECYATHINA* (Okulitch).

We are deferring consideration of this Order to a further paper, but there is one form, viz., *Dokidocyathus,* figures of which had already been prepared for the present paper our intention at the time being to associate it with certain simple types which we regard as leading up to the Spirocyathidae. As the plates with these figures have been completed, we deal with *Dokidocyathus* now. Taylor associated *Dokidocyathus* with *Dictyocyathus* in a family *Dictyocyathidae.* Okulitch places this family in the Order *Archaeocyathina. Dokidocyathus* is a very clearly defined type and is fairly plentiful at the Ajax; its regular conical form, and its regular and numerous pores, which are seldom obscured by secondary silicification, appear to indicate relationship to *Archaeocyathidae* and *Coscinocyathidae;* in the spitz of *Dokidocyathus* which we have found, and which is shown in Fig. 52, the bars are much closer together than in the upper part, and increase the resemblance to *Archaeocyathus;* all these forms are no doubt derived from a form like *Monocyathus.* On the other hand, *Dictyocyathus,* as will be seen, appears to be the starting point of the *Spirocyathus* line of evolution, for which we propose a new Order, *Spirocyathina.* It appears necessary to separate *Dokidocyathus* and make it the type of a new family.

New Family *DOKIDOCYATHIDAE.*

Regular conical forms; outer and inner walls with regular closely-set circular pores; the two walls connected in the mature state by remote flattened bars. In one form even these bars are absent. The spitz has more numerous bars. Contains one genus, *Dokidocyathus* (Taylor).

Dokidocyathus simplicissimus (Taylor).

Plate X., Fig. 51, shows the structure of a mature specimen. A is a longitudinal section showing outer wall to left and right, the middle part being ground away to expose the inner wall. In both walls a change in size of the pores is noticeable. B is a transverse section of the same specimen.

Fig. 52A shows a longitudinal view of a spitz, the connecting bars being much more closely set than in the adult; B is a transverse section of the same specimen at a rather higher level, with remote bars.

Plate XI., Fig. 23, is a reconstruction, natural size, of a complete specimen.

Dokidocyathus Nihilum N.SP. Plate XI., Fig. 54.

Conical tube; intervallum co-efficient 4 mm.: 24 mm. Outer and inner wall pores nearly equal in size, numerous and regularly arranged, about 2 to 1 mm. Outer wall thicker than inner. No trace can be seen of connecting rods between the walls; if any are present they must be

at very remote intervals. Three specimens have been found, all with similar features. The species differs from *D. simplicissimus* in the outer wall being thicker than the inner, in the smaller and more uniform size of outer and inner wall-pores and the absence of connecting bars.

New Order *SPIROCYATHINA.*

This Order represents a line of evolution distinct from the Archaeocyathina. Whereas the latter originate from a *Monocyathus*-like spitz with markedly perforate (outer) wall to which definite septa and perforate inner wall are quickly added, the simplest forms of the *Spirocyathina*, e.g., *Dictyocyathus*, possess an outer wall in which pores are usually masked by secondary silicification, a regularly perforate inner wall, and, connecting the two walls, at first radial rods and then a delicate network of anastomosing rods. From spitzes of this type we find developed in the family *Spirocyathidae* an intervallum system of hexagonal hollow lattices which, leaving the outer wall nearly horizontally curve downwards as they proceed inwards towards the inner wall; concurrently with this development the inner wall pores are frequently converted into large channels leading upwards and inwards into the central cavity.

From this condition two lines of evolution are followed. In one the side members of the hexagonal lattice become flattened and plate-like, to form septa, the top and bottom members of the lattice remaining as synapticulae, a condition seen in *Pycnoidocyathus synapticulosus* (Taylor), which we therefore remove from the *Archaeocyathina* and include in the present order; loss of the synapticulae results in *Pycnoidocyathus maximipora* (Bedford). In the other line of evolution the curved hexagonal lattice becomes defined as a curved hexagonal tube, as in *Syringocnema favus* (Taylor).

The order presents a very clear case of convergent evolution, the septa of *Pycnoidocyathus* having a close resemblance to those of *Archaeocyathus*, but having a totally different mode of origin. There is good reason to believe that several other examples of convergent evolution occur within the class. Tabulae or tabula-like structures appear to have arisen several times quite independent of the *Cosinocyathidae*. Further research will be needed to define many points, but it is already clear that convergent evolution must be taken into account in classifying the Archaeos.

We divide the *Spirocyathina* into five families, *Dictyocyathidae*, *Dictyocoscinidae*, *Spirocyathidae*, *Syringocnemidae*, and *Sigmofungidae*.

Family *DICTYOCYATHIDAE* (Taylor).

After removing the genus *Dokidocyathus* from this family, there remains only the genus *Dictyocyathus* (Bornemann). Taylor defines the genus "Intervallum without continuous septa, and only united by numerous rounded rod-like rafters." In the spitzes and the simpler forms the rods are simple, in other forms they anastomose to form a delicate, open mesh. The outer wall is often coated, obscuring the pores.

Dictyocyathus annularis, N.Sp. Plate XI., Fig. 55.

Small tubular form; intervallum co-efficient 5 mm., 2 mm. Outer wall pores are obscured in the type specimen, but a second specimen (Fig. 55E) shows small irregular pores, 3 or 4 to 1 mm. The short connecting rods in the intervallum tend to anastomose into horizontal rings Ca and D). The inner wall has small circular pores, 3 or 4 to 1 mm (Cb). A is a transverse, B a longitudinal view of the type specimen. C and D are the same further enlarged.

Dictyocyathus irregularis (Taylor).

In Plate XI., Fig. 56, is shown a specimen which is no doubt this species. The outer wall is coated with a desposit which, from its horizontal striae, appears to be definitely organic; it is an extreme example of the coating which so often obscures the outer wall pores of the Spirocyathina.

Dictyocyathus fragilis, N.Sp. Plate XI., Fig. 57.

The species resembles the foregoing. It shows a similar striated coating to the outer wall. The intervallum network is more open and delicate, and the inner wall is more openly porous than that of *D. irregularis*. The general form is a cylinder with external corrugations instead of being conical like the preceding species. Two specimens have been found.

Dictyocyathus robustus, N.Sp. Plate XII., Fig. 58.

Gently tapering cone; intervallum co-officient 2 mm.: 6 mm. Outer wall coated with circular striae (Fig. 58, D). Connecting rods numerous, simple and horizontal in the lower 13 mm. of the specimen; just at the top of the specimen vertical and horizontal connecting bars begin to appear Aa and C). The inner wall is strong and rugged, the pores near the top of the specimen being nearly 1 mm. in diameter and 2 mm. apart. A, B, longitudinal section; C,, transverse section of upper part; D, surface view at upper part. Only one specimen has been found.

Dictyocyathus quadruplex, N.Sp. Plate XII., Figs. 59, 60.

The type specimen is a fragment of an expanding cone; intervallum co-efficient 3 mm.; 15 mm. The outer wall is mostly lost and what little is left is obscured and no pores are visible. Just under the wall the ends of the intervallar rods form a fairly regularly quadrate pattern; these merge into a delicate, open mesh. The inner wall is lighter and more openly porous than that of *D. robustus*.

Fig 59, A shows, above, fragments of the outer wall and the quadrate arrangement of the ends of intervallar rods; lower down is an oblique section through the intervallar mesh, reaching to the inner wall (IW). B shows the inner wall.

Fig. 60 shows a conical specimen which may be a lower part of the same species. In this the outer wall shows a circular striated coat somewhat like those noted in the two previous species.

Only these two specimens have been found.

Dictyocyathus Macdonnelli, N.Sp. Plate XII., Fig. 61.

The specimen is conical, intervallum co-efficient 3 mm.: 11 mm. Fairly numerous scattered rods cross the intervallum. The preservation is too poor to show wall pores. Locality: Macdonnell Ranges, Central Australia.

New Family *DICTYOCOSCINIDAE.*

Two walls are present connected by an open mesh similar to that of *Dictyocyathus.* At intervals a series of horizontal sieve-plates fill the interstices of the mesh, forming a tabular structure resembling that of *Coscinocyathus.* Only one specimen has been found at the Ajax, for which we form the new genus *Dictyocoscinus,* having the above characters, with *Dictyocoscinus Beltana* as genotype; but Vologdin has described three genera, *Altaicyathus, Claruscyathus,* and *Tabulacyathus,* and Taylor a genus *Archaeosycon* which have points of resemblance.

Dictyocoscinus Beltana, New Genus and Species. Plate XII., Fig. 62.

An irregular cone; intervallum co-efficient about 4 mm.: 12 mm. Outer wall not well seen; intervallum filled with a delicate open mesh similar to that of *Dictyocyathus.* At vertical intervals of 3 or 4 mm. horizontal sieve-plates fill the mesh, contiguous sieve-plates uniting to form a more or less horizontal "tabula" (A and B a, b); inner wall with numerous closely set pores about two to 1 mm.

Only one fragment has been found.

Family *SPIROCYATHIDAE* (Taylor).

Four genera of this family occur at the Ajax, *Protopharetra, Spirocyathus, Metafungia,* and *Pycnoidocyathus;* Vologdin describes another genus *Retecyathus* from Siberia.

Genus *PROTOPHARETRA* (Bornemann).

Taylor defines the genus as follows: "The intervallum is filled with irregular tissue, which is composed of flattened or cylindrical calcareous fibres, central cavity narrow." It is a little difficult to draw a clear line of division from *Dictyocyathus* on the one hand and *Spirocyathus* on the other. It is suggested that *Dictyocyathus* includes the forms in which the intervallar mesh is open, composed of light cylindrical rods running for the most part straight from node to node or from wall to wall; that *Protopharetra* include forms in which the intervallar tissue is more crowded and less rod-like, with little or no tendency to a radial or septal arrangement and with inner wall pores which are not converted into channels leading upwards and inwards into the central cavity; that *Spirocyathus* include forms with more or less radial orientation and with a tendency to large inner wall channels leading upwards and inwards into the central cavity.

Protopharetra graphica (Bedford). Plate XIII., Fig. 63.

A shows a surface view (a) and longitudinal section (b) of a reconstructed specimen; B is a transverse, and C an oblique longitudinal section of a spitz. See also Part I, p. 4, 5, and Plate IV., Fig 22

Genus *SPIROCYATHUS.*

Spirocyathus irregularis (Taylor). Plate XIII, Fig. 64.

Fig. 64 is given for comparison with other forms and to supplement Taylor's description. A is a sketch, natural size, to show the general form; the small excrescence on the left is a young *Protopharetra graphica* grafted on to the *Spirocyathus.* The outer wall has numerous small pores, about 4 to 1 mm., like those shown in Fig. 66, C; Taylor does not seem to have seen these, as, like so many specimens in this order the outer wall is often obscured by secondary silicification. B is a radial longitudinal section showing septa and synapticulae. C is a view of the natural rim of a specimen. D shows the inner wall pores which are regularly arranged, about 1 mm. apart, and lead upwards and inwards into the central cavity.

Spirocyathus multifidus, N.Sp. Plate XIII., Fig. 65.

Shape cylindro-conical, with slightly waved wall, similar to *S. irregularis.* Intervallum co-efficient 4 mm.; 13 mm. The outer wall pores are obscured. The intervallar tissue is on a very fine scale; it shows considerable radial tendency and the curvature of the septal and synapticular lines in radial section is marked. The inner wall pores are numerous, 2 or 3 to 1 mm., and do not lead upwards and inwards into the central cavity. The wide intervallum distinguishes it from *Protopharetra graphica,* and the fineness of structure distinguishes it from other *Spirocyathi.* A shows a transverse section; B a radial longitudinal section;; C a tangential longitudinal section of inner wall and subjacent tissue.

Spirocyathus ptychophragma. Plate XIII., Fig. 66, and Plate XIV., Fig. 67.

This species was described by Taylor as *Pycnoidocyathus ptychophragma.* It may be distinguished from

related forms by the combination of a coarse intervallar structure with comparatively small inner wall pores. The wall is wavy in the lower part and passes into definite flanges in the upper part. The outer wall has numerous small pores (Fig. 66C and Fig 67E), but, as usual, these are often obscured. The principle of the construction of the intervallar tissue is shown schematically in Fig 67, D, H, J; D being a radial longitudinal section; H an oblique transverse section in a plane parallel to e—g (Fig 67D); J an oblique transverse section in a plane parallel to Df (Fig. 67D). The structure may be visualised as a series of curved hexagonal-tubular lattices; these lattices are cut across in J, and are cut lengthwise in H; if the sections touch the rod-like elements of the lattice a radial ladder-like effect is given in H, or a hexagonal honeycomb in J; if the sections cut across the rods, a rectangular arrangement of dots is given in H, or a hexagonal arrangement in J.

From this type of structure the various septal forms met with in the Spirocyathidae may be readily derived. Thickening of the two planes of mesh which approach the plane of the paper in Fig. 67D gives rise to wavy septa, and if the rods at right angles to the plane of the paper remain unmodified they appear as synaticulae; this condition is realised in *Pycnoidocyathus synaticulosus.* Flattening of the septal waves and progressive disappearance of the synapticulae results in *Pycnoidocyathus sixplex* and *maximipora.* A different modification, with accentuation of the tubular character of the lattice, gives rise to *Syringocnema.* This type of structure explains the very misleading information given by a single chance section of one of the *Spirocyathidae;* one and the same specimen, by a very small difference in orientation of the section, may appear to have definite radial structure or not; or it may show radial structure near the inner wall and *Protopharetra*-like structure near the outer wall, or vice versa.

Fig. 66 is from ane specimen; Fig. 67, A, E. F. from another; Fig 67K shows a longitudinal section of a spitz which is probably of this species.

Spirocyathus rete. Fig. 68.

The species was described by Taylor as *Protopharetra rete.* It is distinguished from similar species by the combination of a coarse intervallar mesh with a large-pored inner wall; the inner wall pores leading upwards and inwards into the central cavity. The upper part has marked flanges as in *Pycnoidocyathus.* The intervallar tissue is similar to that of *S. ptychophragma.* A shows an actual fossil, natural size; B a transverse; and C a radial longitudinal section. D, E are views of a spitz which is probably of this species.

Genus *PYCNOIDOCYATHUS* (Taylor).

Taylor defines as "Cups in which the outer wall is thrown into deep horizontal bulges. Usually synapticulate. Septa within the peripheral bulges highly irregular." He places the genus in the family *Archaeocyathidae.* We have now given reasons for placing these forms in the *Spirocyathidae; P. ptychophragma* has been referred by us to the genus *Spirocyathus,* and we confine the name *Pycnoidocyathus* to those forms which possess definite septa and show the deep bulges.

Pycnoidocyathus synapticulosus (Taylor). Plate XV., Fig. 69.

A shows a remarkably fine specimen, natural size; B shows the outer wall, C a transverse section, and E the inner wall of the same specimen. F shows the inner wall of an unusual variety in which the sloping plates leading upwards and inwards into the central cavity are replaced by simple bars. G is a transverse section of a variety in which the inner wall pores are considerably larger in proportion to the scale of mesh of the intervallar tissue.

Pycnoidocyathus simplex (Taylor). Plate XV., Fig. 70.

The figure shows a good specimen natural size.

Pycnoidocyathus maximipora (Bedford). Plate XV., Fig. 71.

The figure shows half of the type specimen, natural size. See also Part 1 page 3, and Plate II., Fig. 9. In this species the septa are almost completely flattened and the synapticulae have practically disappeared, but a little trabecular tissue still remains close to the outer wall, and the inner wall is markedly of the *Spirocyathus-Pycnoidocyathus type.*

Pycnoidocyathus vicinisepta, N.Sp. Plate XVI., Fig. 72.

The species has very clearly defined radial septa and synapticulae; the septa are much closer and the inner wall-pores smaller than in the previous species. A shows obverse and reverse views of the type specimen, natural size; B is a reconstruction from this specimen; C shows the inner wall, D a transverse section, and E a radial longitudinal section. F shows the outer wall, and G a radial longitudinal section near the base of another specimen.

Pycnoidocyathus parvulus, N.Sp. Plate XVI., Fig. 73.

This is a miniature edition of *Pcynoidocyathus,* being smaller in all respects than other species. A is a view of the type specimen, natural size. B shows a transverse section, C the inner wall pores and D a radial longitudinal section.

The specimens described in our former paper as *Spirocyathus major* and *S. speciosus* are probably the apical portions of *Pycnoidocyathus Maximipora,* and *P. simplex,* respectively.

Genus *METAFUNGIA* (Bedford).

Metafungia reticulata (Bedford). Plate XIX., Fig. 81.

In Part I., page 5, plate IV., Fig. 23 we described this species and, on account of the absence of central cavity in the base and the presence of dissepimental tissue, included it with such forms as *Metaldetes* in a new family, *Metacyathidae.* It now appears preferable to relate it to the *Spirocyathidae* on account of the synapticulae and the nature of the septa. We have given reasons for relating such synapticulate forms as *Pycnoidocyathus* to the *Spirocyathidae,* and the proposed alteration brings all synapticulate forms from the Ajax together in one order. The genus may be re-defined as Archaeos having definite though irregular and highly porous septa and numerous regularly arrayed synapticulae; in the base the central cavity is absent, its place being taken by trabecular and dissepimental tissue; the outer surface is wavy but is not thrown into prominent flanges. Fig. 81 shows first a natural size longitudinal view of the fossil, next an enlarged radial longitudinal section in which a is the outer wall, b a trabecular zone within the outer wall, c septum and synapticulae, d thickened septum near the inner wall, e inner wall. A tangential section of the inner wall is also shown. For further details see Part I.

New Family *SIGMOFUNGIDAE.* Plate XIX., Fig. 82.

New Genus *SIGMOFUNGIA.*

Archaeos having clearly defined radial septa which may be more or less irregular, with numerous synapticulae; the inner wall pores are in vertical rows, each pore being separated from those above and below it by a sigmoidally curved plate *Sigmofungia* is at present the only genus in the family, and *S. Flindersi* the only species. It is placed in the order *Spirocyathina* principally because of the numerous synapticulae, and in other respects, except for the sigmoidal pores, it does not differ materially from typical members of the order.

Sigmoifungia Flindersi, N.Sp. Plate XIX., Fig. 82.

Cylindrical, intervallum co-efficient 8 mm.: 25 mm.; outer wall a finely porous layer supported by a trabecular mesh; septa numerous, somewhat wavy and irregular with numerous rather fine pores, synapticulae numerous; inner wall has numerous pores, closely set, two to 1 mm., very regularly arranged in vertical rows; each pore is separated from those above and below it by a sigmoidally curved plate directed upwards and inwards into the central cavity. The central cavity of the lower part is invaded by a remarkable trabecular tissue which is orientated in relation to the porous structure of the inner wall (Fig. 82, A and F, the arrow in the latter shows centre line of the section).

Family *SYRINGOCNEMIDAE* (Taylor).

The family has at present only one genus and species *Syringocnema favus* (Taylor).

Syringocnema favus (Taylor). Plate XVII., Fig. 74.

We have a considerable amount of fresh material to supplement Taylor's description of this very interesting form. The outer wall is often obscured with silica, so that the outer ends of the radial tubular elements are frequently covered by an impervious convex cap, but in favorable specimens it can be seen that tubercles grow inwards towards the lumen of each tube and by anastomosing form an external series of sieve plates; see Fig. 74 C. The radial tubes in the intervallum are not entirely horizontal, as described by Taylor, but are seen in radial longitudinal section to curve and dip sharply downwards towards the central cavity; see Fig. 74 E. In transverse section (Fig 74 B) the vesicular appearance near the inner wall is due to several tubes being cut across in their sharply-dipping inner parts; the tubes retain their individuality and do not "unite to form a narrow vesicular zone," as Taylor describes them. An internal view of the inner wall is seen in Fig. 74 D; the section is slightly oblique so that at the top are seen processes projecting into the central cavity, next the rectangular inner ends of the tubes, then the pores, and at the lower part of the figure the tubes again, just outside the inner wall. Successive tangential longitudinal sections cutting across a single tubular element are seen in Fig 74 F; 1 shows the processes within the central cavity, 2 the inner end of the tube, 3 the inner wall pores, 4 the tube assuming a hexagonal shape and enlarging in width in 5 and 6 as it passes horizontally outwards, and 7 the outer wall. By comparing this series with the radial longitudinal section (Fig. 74 E) the construction is clearly seen. Fig. 74 A shows a reconstruction, natural size. Fig. 74 G shows a spitz in longitudinal section; the base is seen to consist of *Dictyocyathus*-like tissue which quickly develops a central cavity and curved radial elements; at first the trabecular tissue encroaches on the central cavity. The inner wall is at first less complex than thatof the mature specimen, and is a simple porous structure resembling that of *Dictyocyathus.* Taylor, in his original description, pointed out that *Syringocnema* has some features of resemblance to *Pycnoidocyathus ptychophragma;* he placed the latter in the family *Archaeocyathidae.* We have placed the latter in the genus *Spirocyathus;* and *Syringocnema* also in the new order *Spirocyathina.*

New Order *METACYATHINA.*

We have previously referred to the spitzes or early stages of the orders *Archaeocyathina* and *Sprocyathina.* The spitz in the latter order is in nearly all cases a

simple structure, with outer wall and inner wall (the latter a normally-porous structure) connected by a simple system of rods or trabecular mesh; this spitz is usually a pointed structure carrying on the general contour of the more or less conical organism. In the *Spirocyathina* there appears to be clear evidence of septa being formed indirectly and phylogenetically by the thickening and flattening of the sides of a trabecular lattice—an entirely different mode of origin from the direct formation met with in *Archaeocyathina.* The order *Metacyathina* shows still another mode of origin of septa; whereas in *Spirocyathina* the septal development is phylogenetic and is traceable by the comparative study of a series of species; in *Metacyathina* the development is ontogenetic, septa forming in the upper part of a cup of which the base has no septa or central cavity or inner wall, but is filled with an irregular, trabecular and disseptimental mass of tissue; the base of *Metacyathina* is not a sharp conical spitz, but an irregular mass. The majority of the septate forms of the *Spirocyathina* are characterised by synapticulae, and even those which no longer show synapticulae appear to be derived from synapticulate forms. Synapticulae seldom occur in the *Metacyathina;* on the other hand, a characteristic feature is the frequent presence, especially in the base, of "dissepiments," irregular curved plates which are not for the most part porous. The distinction is not absolute, because *Metafungia* has a few dissepiments as well as numerous synapticulae, and *Metaldetes spiralis* has a few synapticulae. Dissepiments are also occasionally seen in *Archaeocyathina* in repair tissue at the site of an old injury or fracture: their presence here and in the irregular base of *Metacyathina* rather indicates their being of the nature of proliferating embryonic tissue. Whatever may be the relationship of *Metacyathina* to *Archaeocyathina* on the one hand, and to *Spirocyathina* on the other, and whether they be ultimately considered worthy of ordinal rank or not, the more typical genera (e.g. *Metacyathus* and *Metaldetes*) form a very characteristic group, and the same may be said of *Metacoscinus.* There are also some other abnormal *Coscinocyathus*-like forms which may be placed provisionally in this order. The independent origin of septa in *Spirocyathina* seems almost certain, and so is the origin of tabula-like structures in *Metacoscinus;* the independent origin in *Archaeocyathus trachealis* has also been observed and will be referred to in our next memoir. There is therefore ground for considering that radial septa may have arisen independently at least three times, and tabulae or tabula-like structures perhaps five times within the class. Much remains to be done to clear up the affinities of the *Metacyathina,* but it is clear that Bornemann's theory that *Protopharetra* is the vegetative stage of more regular forms, though not of general applicability, is true in certain limited cases.

New Family *ARCHAEOPHARETRIDAE.* Plate XVII., Fig. 75.

These are small irregular forms which may perhaps represent the primitive form of the *Metacyathina,* corresponding to *Monocyathus* for the *Archaeocyathina* and *Dictyocyathus* for the *Spirocyathina.* We have only found one genus and species so far, *Archaeopharetra tpyica.*

New Genus *ARCHAEOPHARETRA.*

Small irregular tubular organisms, the space within the outer wall filled with a mass of irregular trabecular and dissepimental tissue without central cavity or defined inner wall. Genotype: *Archaecopharetra typica.*

Archaeopharetra typica, N.Sp. Plate XVII., Fig. 75.

The type specimen is an irregularly corrugated tube 3 to 4 mm. diameter and 14 mm. long. The outer wall is coated with silica and pores are not visible; the tissue within is an irregular mass of rods and dissepimental plates, without any definite differentiation of septa, inner wall or central cavity.

Family *METACYATHIDAE* (Bedford).

See Part I, page 5, plates IV., V., Figs. 26, 28 to 31.

The genus *Metafungia* is now removed to the new order *Spirocyathina* and the genus *Metacoscinus* to a new family (see below). The family now contains the genera *Metaldetes* and *Metacyathus* and a new genus *Paracyathus.*

New Genus *PARACYATHUS.* Plate XVII., Fig. 76.

Small conical forms in which the base is filled with irregular trabecular tissue without inner wall or septa, the outer wall having small irregular pores; within a short distance of the base clearly defined radial septa, inner wall and central cavity appear, and the small irregular outer wall pores are replaced by large and regular pores.

Paracyathus parvus, N.Sp.

Genotype of *Paracyathus.* It is a small cone, expanding above, shown natural size in Fig. 76 a. Intervallum co-efficient in upper part about 3 mm.: 9 mm.: with fairly stout and regular septa nearly 1 mm. apart. The outer wall has a single row of large pores to each intersept. The base has the structure given in the generic description; at d, Fig. 76 C a striated coating obscures the pores. It is a difficult little form to place as the nature of the wall pores differs greatly from those of *Metacyathus* and *Metaldetes.* Only one fragment has been found.

Genus *METALDETES* (Taylor).

Metaldetes conicus (Bedford). See part I., page 5, Figs. 26, 28, 31.

A fragment of a large cup is shown natural size in Plate XVIII., Fig. 77. This specimen is rather rugged and irregular, some others are more regularly conical. Taylor's *Archaeocyathus grandipora* is probably the upper part of this or a nearly related species.

Metaldetes superbus, N.Sp. Plate XVIII., Fig. 78.

This handsome form is shown natural size, it differs from other species in the very wide intervallum; co-efficient 15 mm.: 50 mm. *Metaldetes conicus* and *superbus* are two of the largest and most striking species found at the Ajax.

Metaldetes spiralis, N.Sp. Plate XVIII., Fig. 79.

The base of this species is irregular, without central cavity, similar to Plate V. Fig. 31. The general shape is shown in Fig. 79 A. At 30 mm. above the base inner wall and central cavity are well seen, but the septal structure (Fig. 79 B, D) is still irregular, having much the appearance seen in *Spirocyathus rete*, and a few synapticulae being present, but there are indications of the septa becoming more regularly radial at a slightly higher level. The outer wall is shown in Fig. 79 C. The inner wall, Fig. 79 E, has the characteristic structure of *Metaldetes*, being an irregular network totally different from the large channels leading upwards and inwards into the central cavity of *Spirocyathus rete* and its allies.

Genus *METACYATHUS* (Bedford).

Metacyathus Taylori. See Part I., page 5, Fig. 30.

A reconstructed view, natural size, of this striking form is shown in Plate XVIII. Fig. 80.

New Family *METACOSCINIDAE*.

Archaeos which grow from an irregular base filled with irregular trabecular and disseptimental tissue without septa, inner wall or central cavity; at a higher level radial septa occur together with tabulae or structures resembling tabulae. The typical genus is *Metacoscinus* (Bedford) (see Part I.), but two new genera, *Paracoscinus* and *Pycnoidocoscinus*, with regular tabulae, are placed provisionally in the family.

Genus *METACOSCINUS* (Bedford).

Metacoscinus reteseptatum. See Part I., page 6, Fig. 27.

Some additional particulars are now figured. Plate XIX., Fig. 83 A, shows a reconstruction of the complete organism, natural size. B is a sketch of the upper part of a specimen showing the natural rim of the cup; this specimen shows several of the tabula-like structures at TT (see also 27 a, b). Fig. 83 D shows the inner wall of a specimen in which the inner wall mesh is covered with numerous small tubercles.

Metacoscinus insigne, N.Sp. Plate XX., Fig. 84.

This fragment, shown natural size in Fig 84 A, has an outer wall thrown into large and deep corrugations; the outer wall is exceedingly thick a full mm., and has a labyrinthine porous structure seen in transverse section in Fig. 84 B and in surface view in Fig. 84 C; this thick outer wall contrasts strongly with the delicate structure of the remainder of the skeleton. The intervallum is wide, ranging from 6 mm. in the hollows of the outer wall to 12 mm. in the bulges; intervallum co-efficient averages 9 mm.: 35 mm. The septa are straight and have the same open network as is seen in *Metacoscinus reteseptatum* (Fig. 84 D). The inner wall is similar in structure to the latter species; it shows numerous small tubercles projecting inwards from the mesh into the central cavity (upper left corner of Fig. 84 E). Only one fragment has been found; it does not show tabulae, and the base has not been found, but the nature of the septa and inner wall clearly place it in the genus *Metacoscinus*.

New Genus *PARACOSCINUS*. Plate XX., Figs. 85 and 86.

The genus is made for an unusual *Coscinocyathus*-like form which we have difficulty in placing elsewhere, though it must be admitted that the affinity to *Metacoscinus* is not very obvious. The genus may be tentatively defined as having clearly defined septa and closely-set curved tabulae; growing from an irregular base; the outer wall consisting of a finely porous layer supported by an irregular trabecular mesh. Only one species has been found: the genotype *Paracoscinus mirabile*.

Paracoscinus mirabile, N.Sp.

Characters as above. The type specimen is shown natural size in Fig. 85 A. The shape is an irregular cone becoming more cylindrical above. Intervallum co-efficient 4 mm.: 13 mm. The outer wall shows small pores, usually obscured, carried by an irregular mesh, the latter being $\frac{1}{2}$ mm. or so in thickness; Fig. 85 D (lower figure) shows the outer wall, outer view; Fig. 85 D (upper figure) and H show the same, inner view. Septa in the upper part are well defined and numerous, averaging 1 mm. apart; septal pores are rather difficult to make out, aparently they are very small and numerous (Fig. 85 C). Tabulae are numerous and closely set, averaging 1 mm. apart, openly porous with irregular pores (Fig. 84 B); they are strongly arched upwards, the periphery sloping downwards to unite with the mesh which underlies the outer wall (Fig. 85C). The inner wall has numerous regular pores, about two to 1 mm.;

from the nodes tubercles project inwards into the central cavity (Fig. 85 E, left hand). The base is irregular (see Fig. 85 F, G); roots are present (Fig. 85 A).

Fig. 86 shows another fragment, the lower part of a small specimen which resembles the above and may be the same species. The outer wall in this specimen has a striated coating similar to that often seen in *Dictyocyathus* (see Fig. 56 B).

New Genus *PYCNOIDOCOSCINUS*. Plate XX., Fig. 87.

Forms with numerous arched tabulae of unusual type; the outer wall has a finely porous layer supported by a trabecular mesh, and is thrown into large and prominent corrugations resembling those of *Pycnoidocyathus*. Only one species has been found so far: the genotype P. *pycnoideum*.

Pycnoidocoscinus pycnoideum, N.Sp.

This is a comparatively large form, having the characters above mentioned; the wall varies in thickness from 5 mm. in the hollows to as much as 20 mm. in the flanges; the central cavity is about 25 mm. diameter (Fig 87 A). The outer wall has a layer of fine pores supported by an irregular mesh. The septa are straight and numerous, rather less than 1 mm. apart, with very numerous and very fine pores (Fig. 87 D). The tabulae are strongly arched (Fig. 87 D) and consist of an irregular mesh containing fine pores; they average 2 mm. apart. The inner wall is unusual with regular vertical rows of rectangular pores often subdivided by vertical rods in the middle of the intersepts (Fig. 87 E). The base has not been found, so that the position of the species in the family *Metacoscinidae* is doubtful; in any case the details of structure are unlike those of *Coscinocyathus*.

Order *HETEROCYATHINA*.

The only additional fragments we have found of *Heterocyathus minor* confirm, but add little to our previous description. Further consideration of these forms is deferred in the hope of finding additional material.

A Note on the Foregoing Paper

It is clear that the question whether *Archaeocyathi* were originally calcareous or siliceous organisms is of great importance in deciding their relationships. Further examination on this point is necessary, and it to be hoped that expert consideration may be forthcoming; we have not ourselves the technical knowledge needed to form an opinion.

The above classification, as regards the order *Spirocyathina*, and more particularly *Metacyathina*, is put forward as a working hypothetsis, and it will be of interest to know how it fares when Siberian, American, and other forms are re-examined with a view to confirming or amending it. We think our results show that the problem of classification presents great difficulty, and that not only must fine structure of mature specimens be taken into account, but also that of the developmental stages. Convergent evolution is shown to be an important factor in the *Archaeocyathi*. It is evident that a great amount of work remains to be done before anything approaching finality in the classification of the group can be expected.

CORRIGENDA.

MEMOIRS OF THE KYANCUTTA MUSEUM, Kyancutta, South Autralia.
No. 1, March, 1934.
NEW SPECIES OF ARCHAEOCYATHINAE, etc., by R. and W. R. Bedford.

P. 4, Col. 1, L. 53, for. ACANTHOCYATHIDAE read ACANTHINOCYATHIDAE.
P. 4, Col. 2, L. 8, for Acanthocyathus read Acanthinocyathus.
Plate III., for Acanthocyathus read Acanthinocyathus.
Plate V., for reteseptatus read reteseptatum.
Plate VI., for 34. Heterocyathus minor read 34 Heterocyathus major.
P. 5, Col. 2, L. 36, for reticulate read reticulata.
P. 6, Col. 1, L. 57, for reteseptatus read reteseptatum.
P. 7, Col 1, L. 6, for Heterocythus read Heterocyathus.

GENOTYPES of new Genera described are as follows:—
Monocyathus porosus,
Ethmocyathus lineatus,
Acanthinocyathus apertus,
Pinacocyathus spicularis,
Metafungia reticulata,
Metacyathus Taylori,
Metacoscinus reteseptatum;
Heterocyathus minor,
Uranosphaera polyaster,
all the above being new species at the time of publication.

Fig. 37.

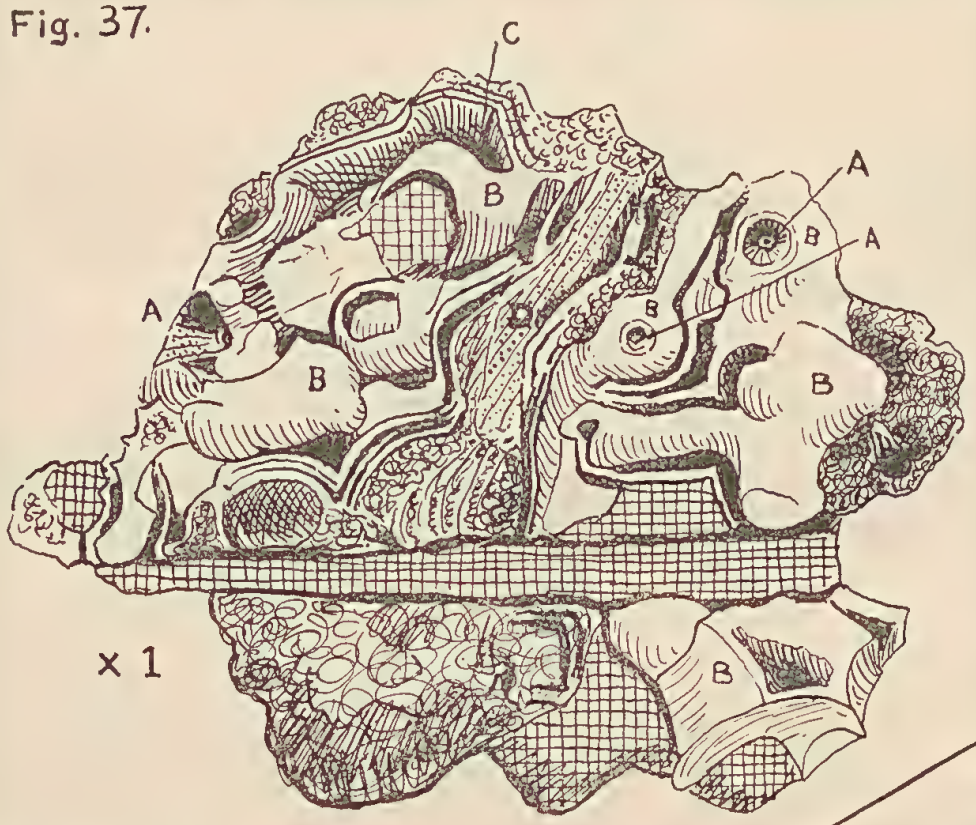


Fig. 40.

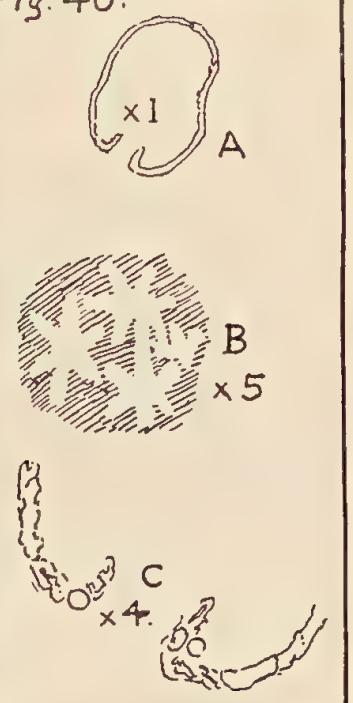


Fig. 39.

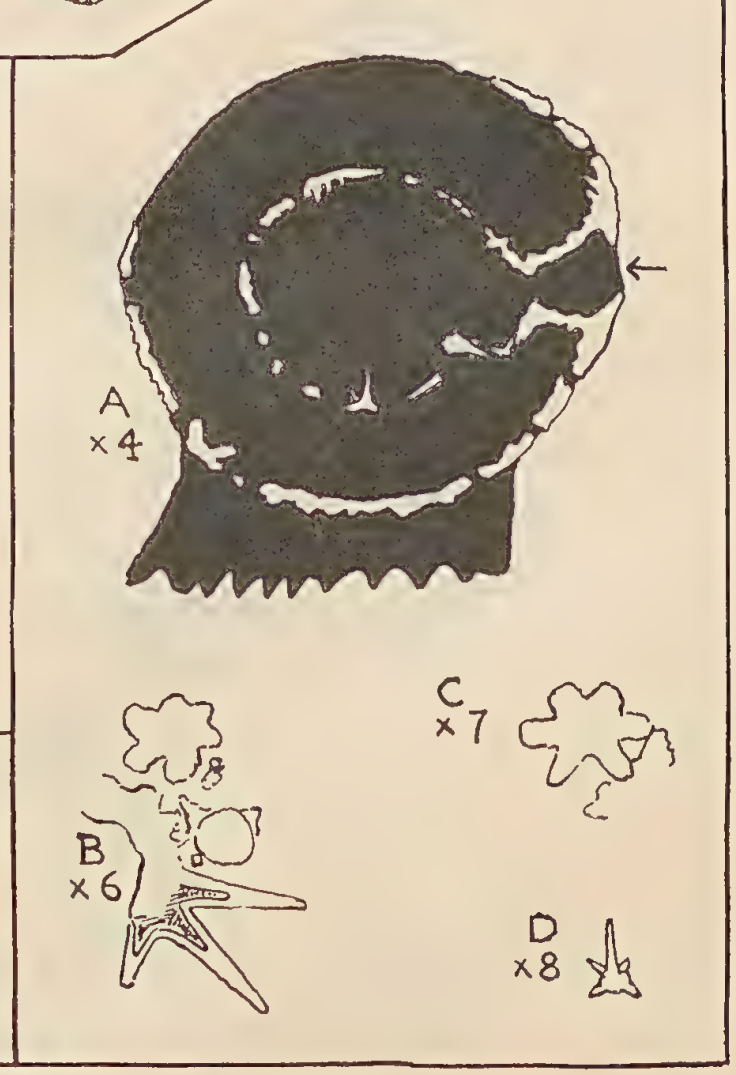


Fig. 38.

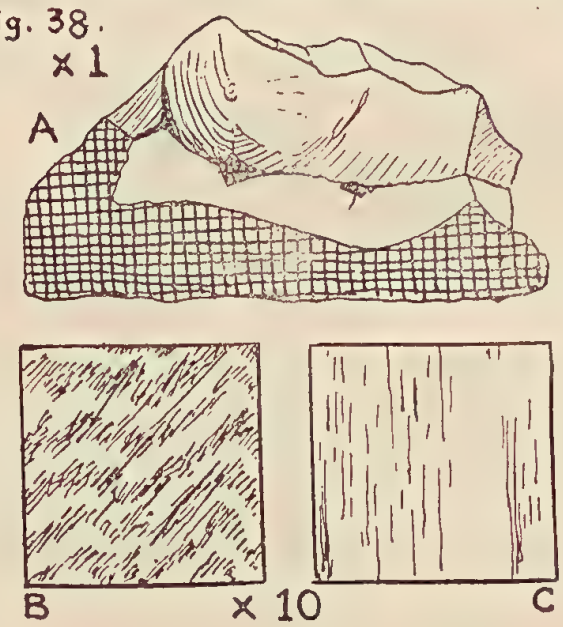
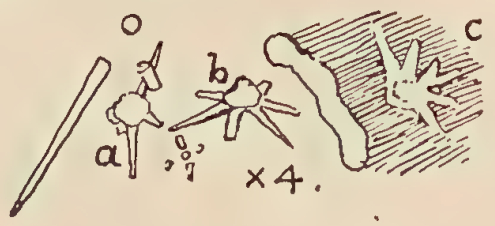


Fig. 41.



RB '36.

37. Ajacia ajax. 38. Beltania beltana. 39, 40, 41. Uranosphaera.

Fig. 42.

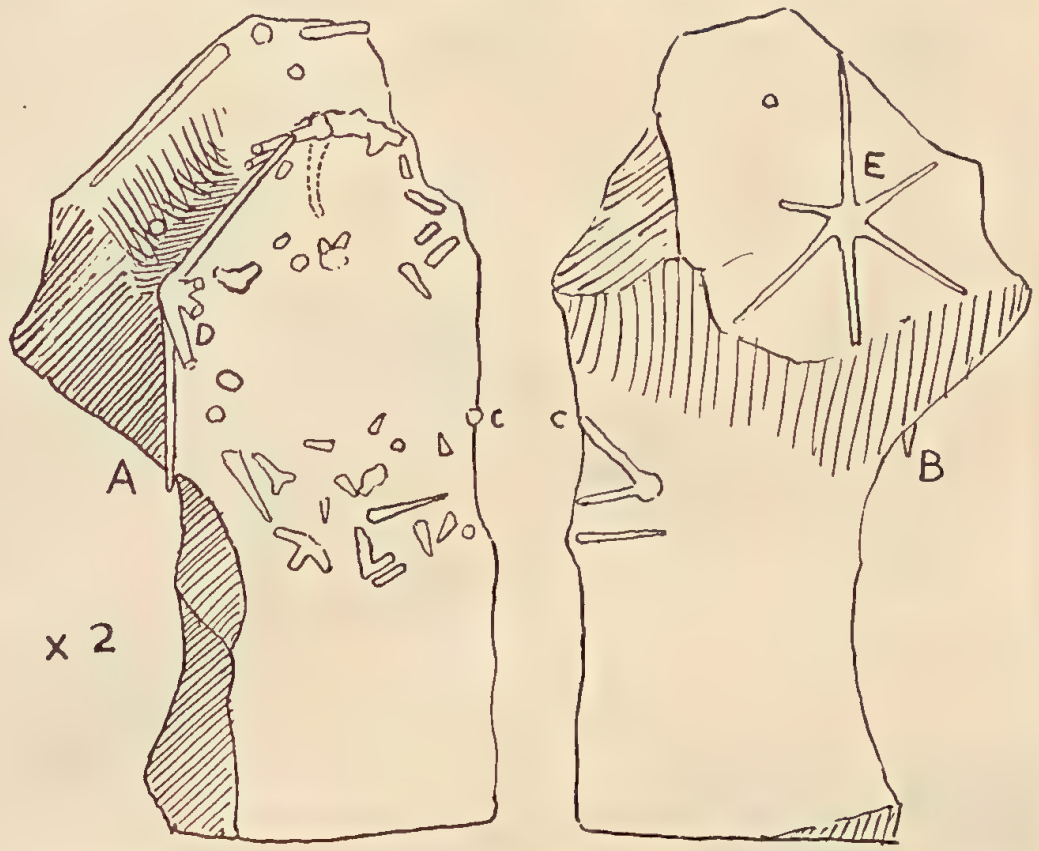
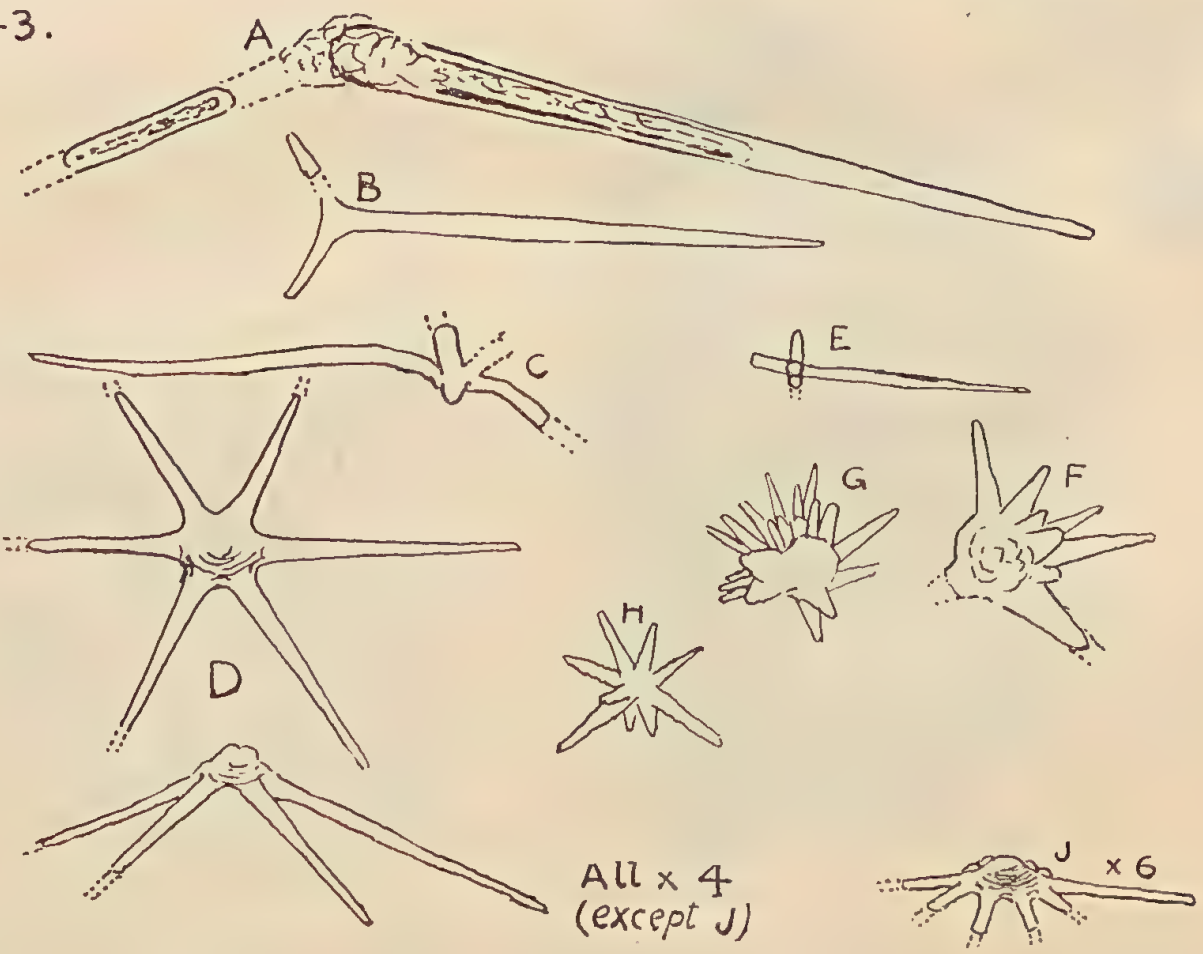
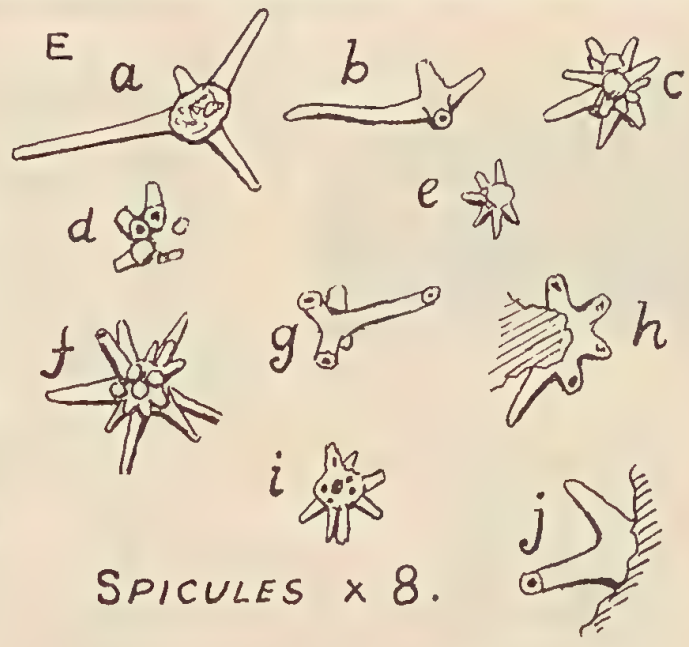


Fig. 43.



Sponge spicules.

Fig. 44.



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Acanthinocyathus apertus.

Fig. 45.

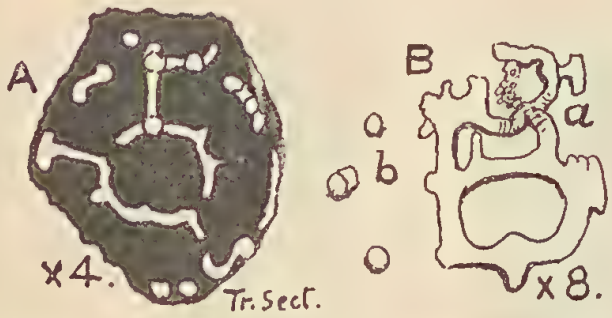


Fig. 46.

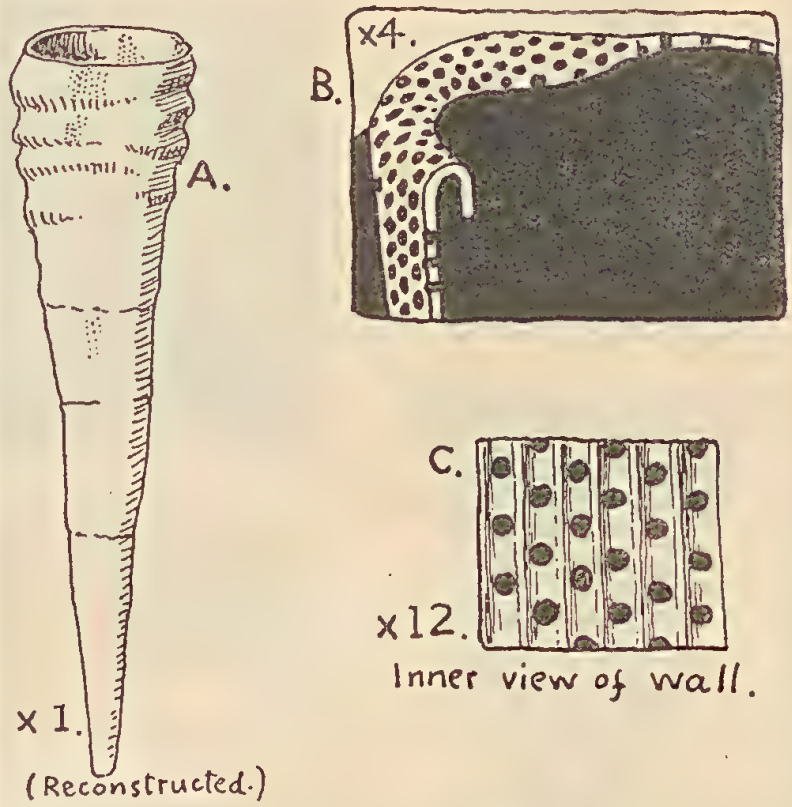


Fig. 47.

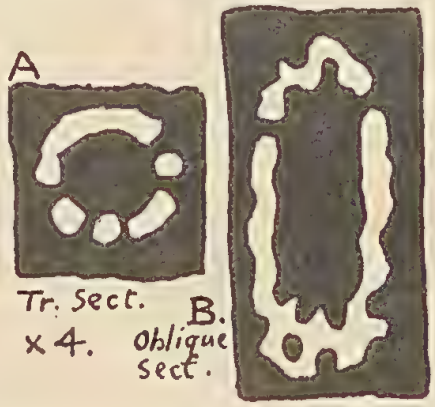


Fig. 48.

Fig. 49.

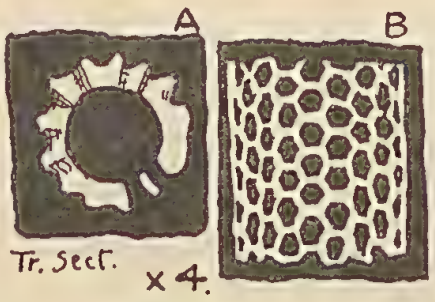


Fig. 50.

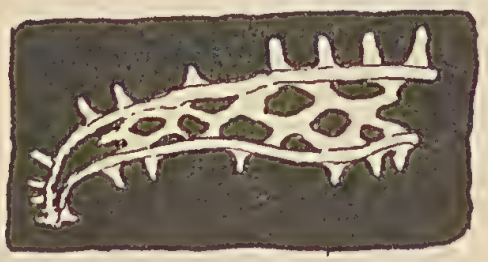


Fig. 51.

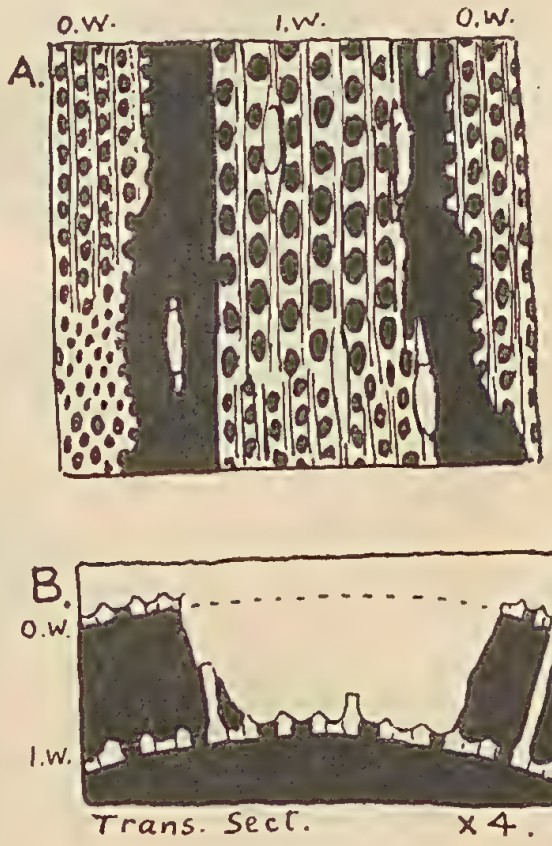


Fig. 52.

RB. '36.

45. Acanthinocyathus. 46. Monocyathus porosus. 47. Monocyathus robustus. 48. Monocyathus sparsipora. 49. Monocyathus mellifer. 50. Monocyathus spinosus. 51, 52. Dokidocyathus simplicissimus.

Fig. 53.

× 1.

Fig. 54.

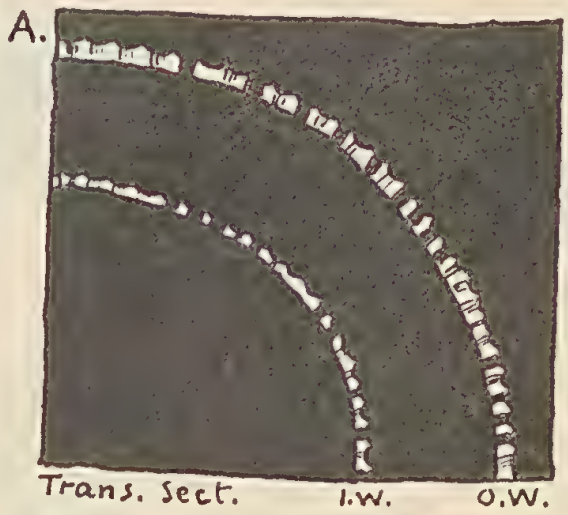


Fig. 55.

Fig. 56.

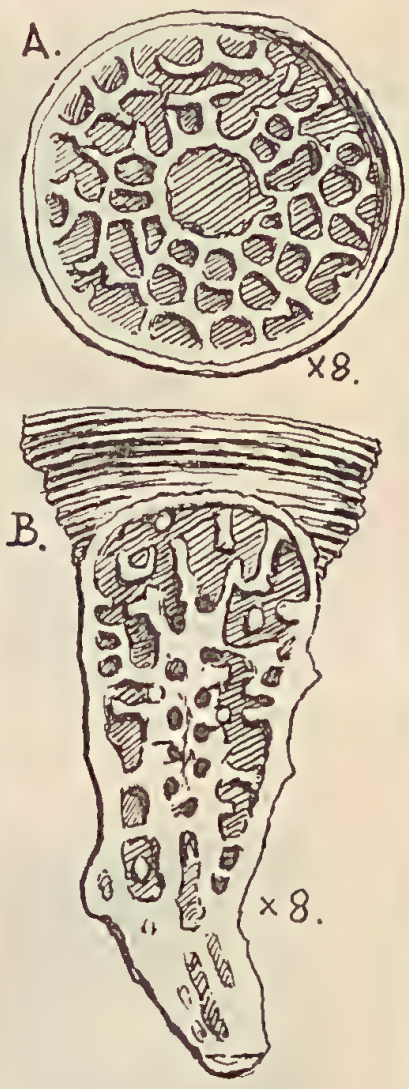
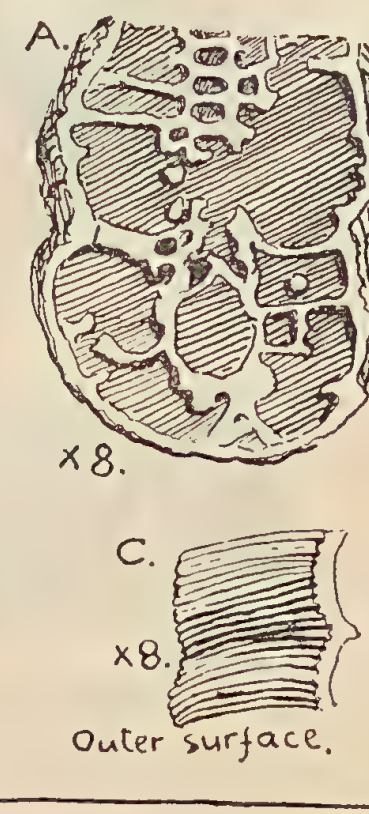


Fig. 57.



R.B. '36.

53. Dokidocyathus simplicissimus. 54. Dokidocyathus nihilum. 55. Dictyocyathus annularis. 56. Dictyocyathus irregularis. 57. Dictyocyathus fragilis.

Fig. 58.

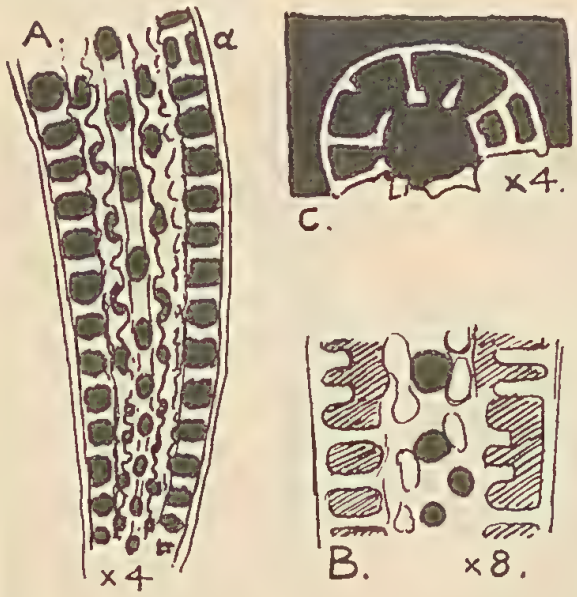


Fig. 59.

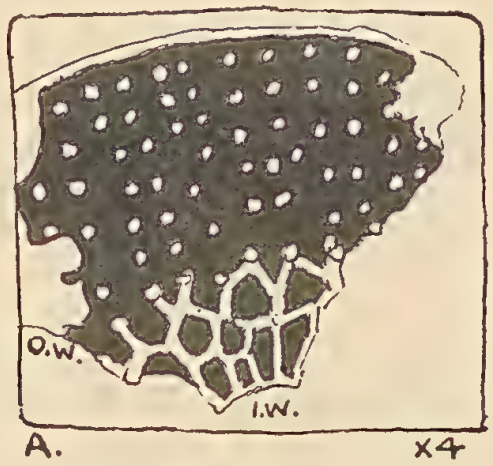
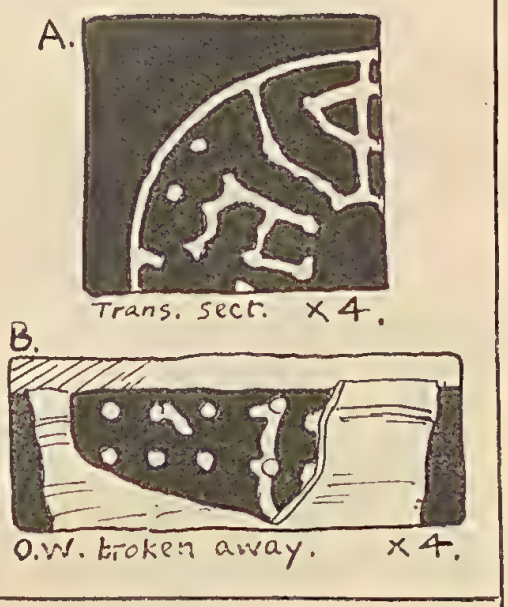


Fig. 61.

Fig. 60.



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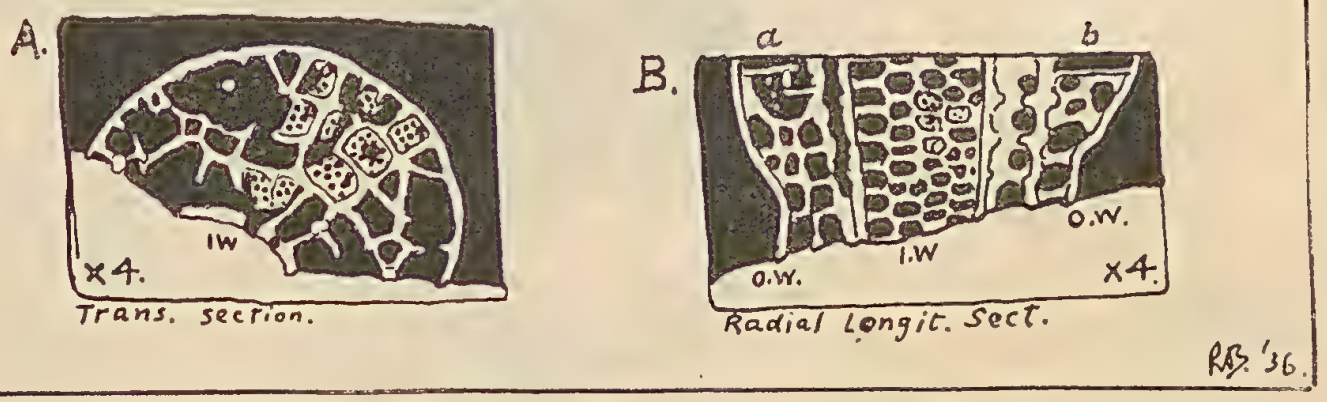
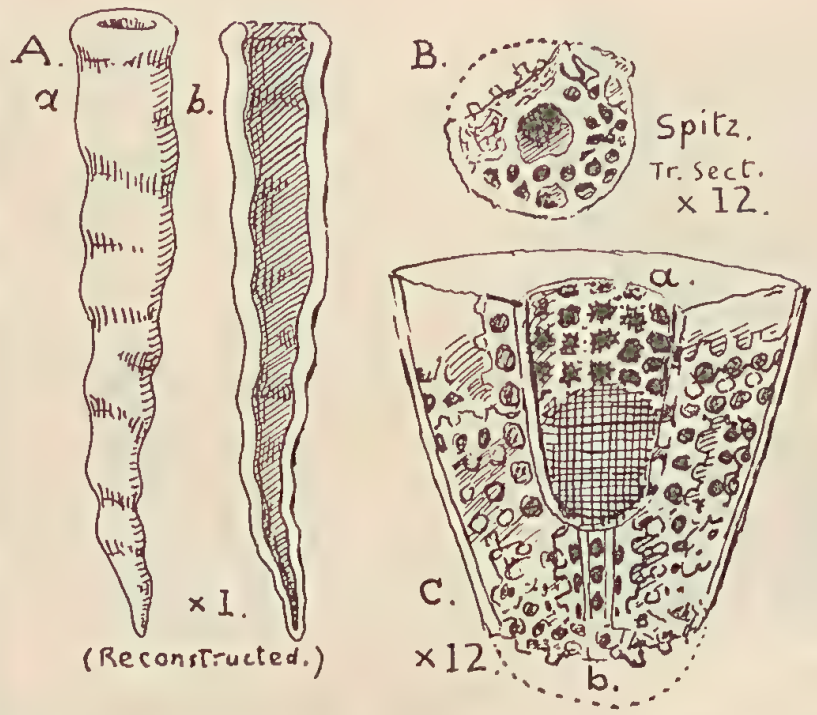


58. Dictyocyathus robustus. 59, 60. Dictyocyathus quadruplex. 61. Dictyocyathus macdonnelli. 62. Dictyocoscinus beltana.

Fig. 63.



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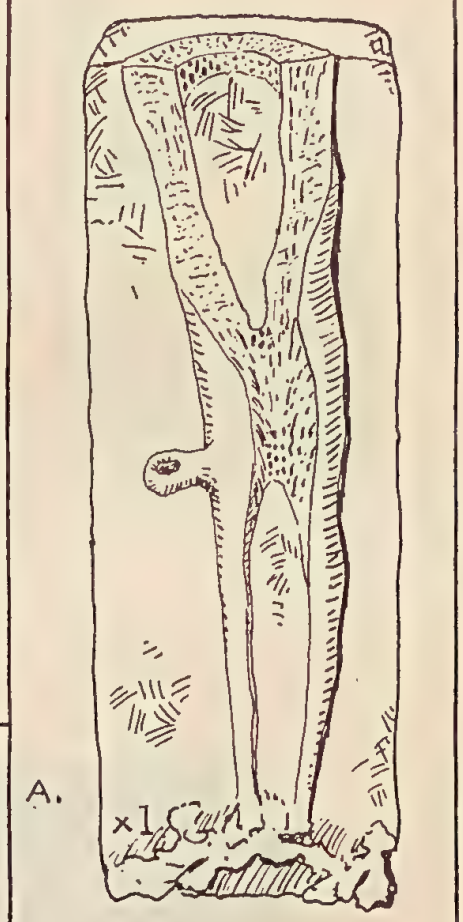
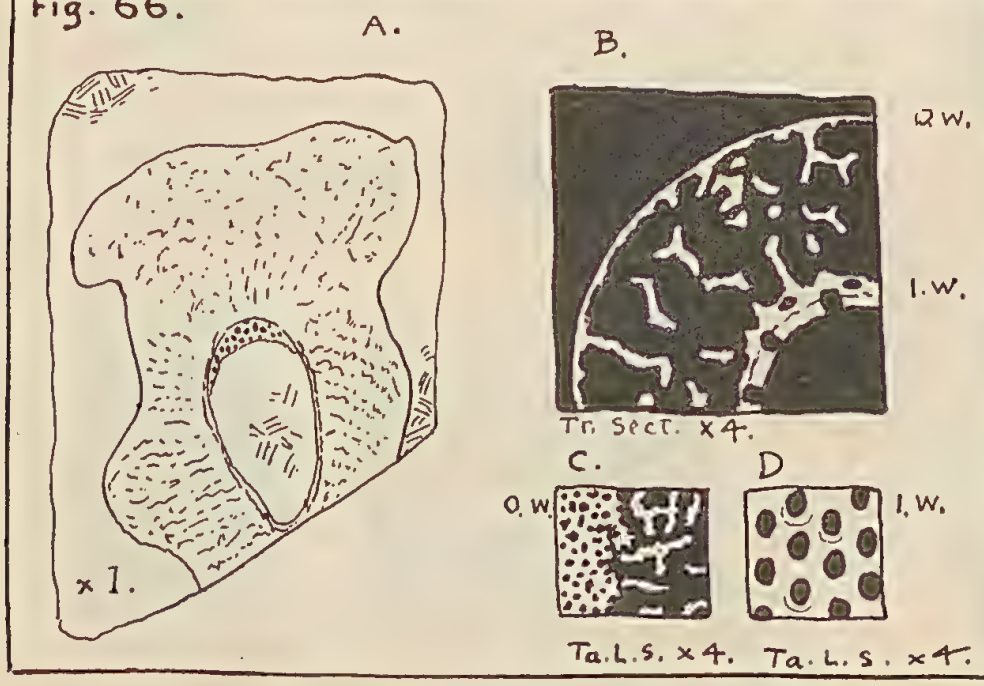
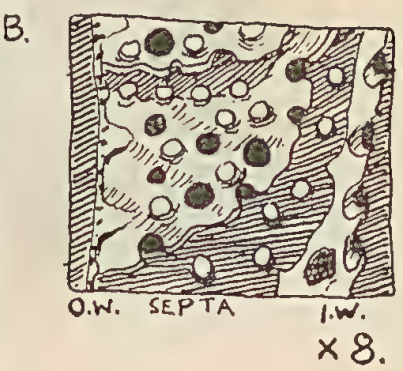
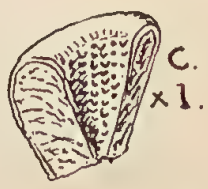


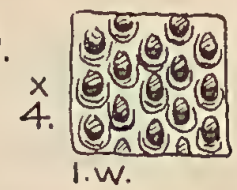
Fig. 65.

Fig. 66.





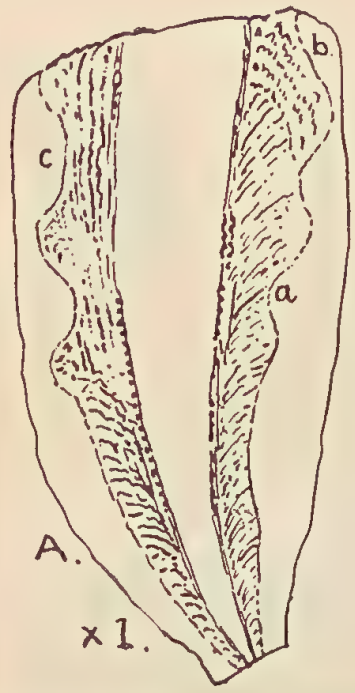




RB. '36.

63. Protopharetra graphica. 64. Spirocyathus irregularis. 65. Spirocyathus multifidus, 66. Spirocyathus ptychophragma.

Fig. 67.



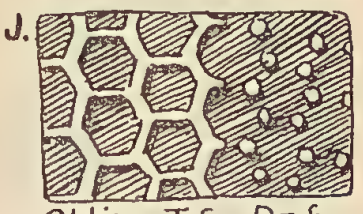
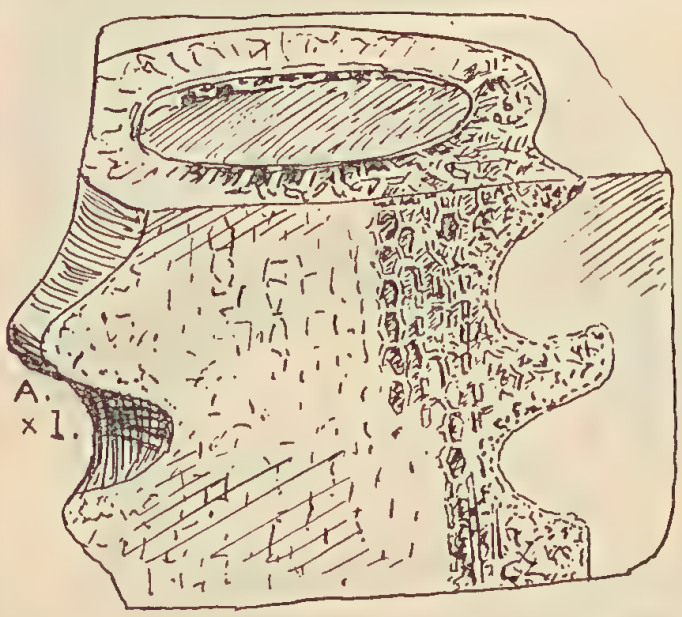


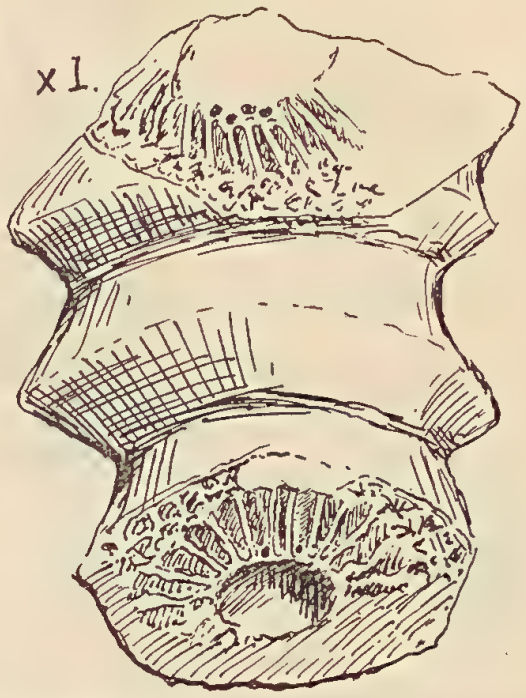
Fig. 68.



67. Spirocyathus ptychophragma. 68. Spirocyathus rete.

Fig. 69.

Fig. 70.



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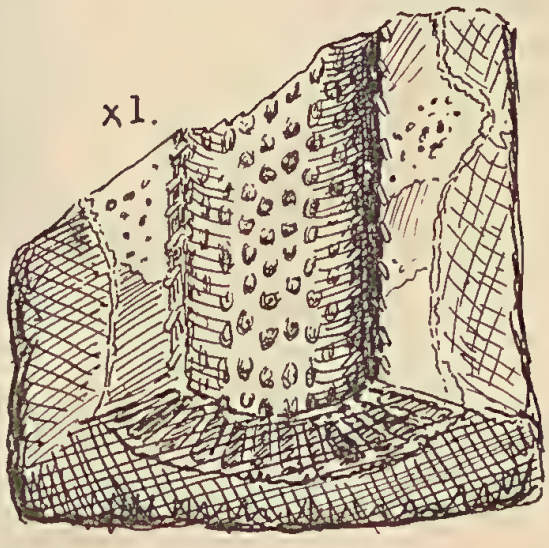
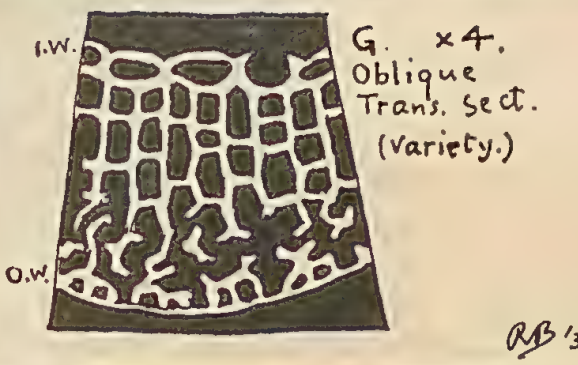




RB '36.

69. Pycnoidocyathus synapticulosus. 70. Pycnoidocyathus simplex. 71. Pycnoidocyathus maximipora.

Fig. 72.

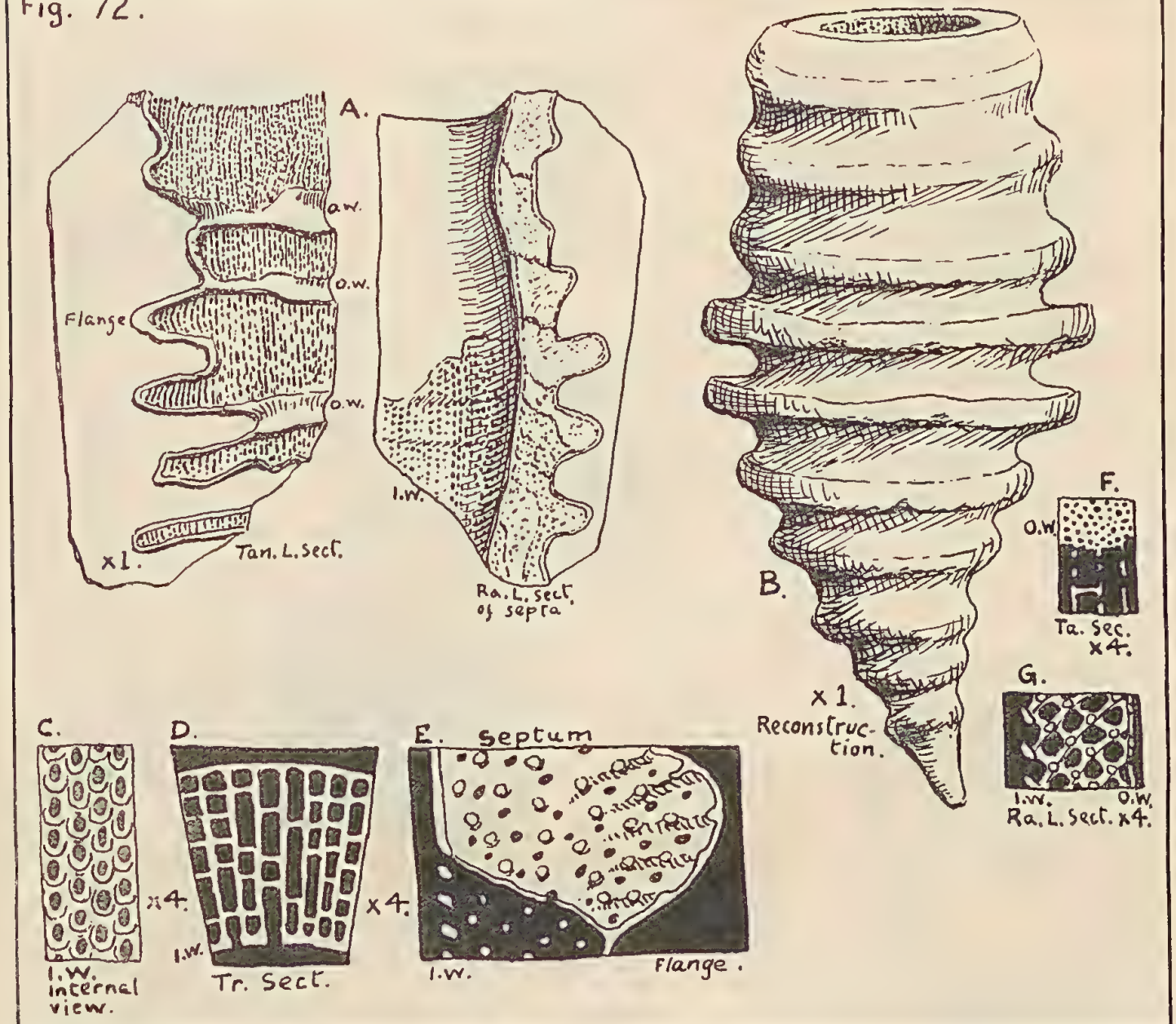
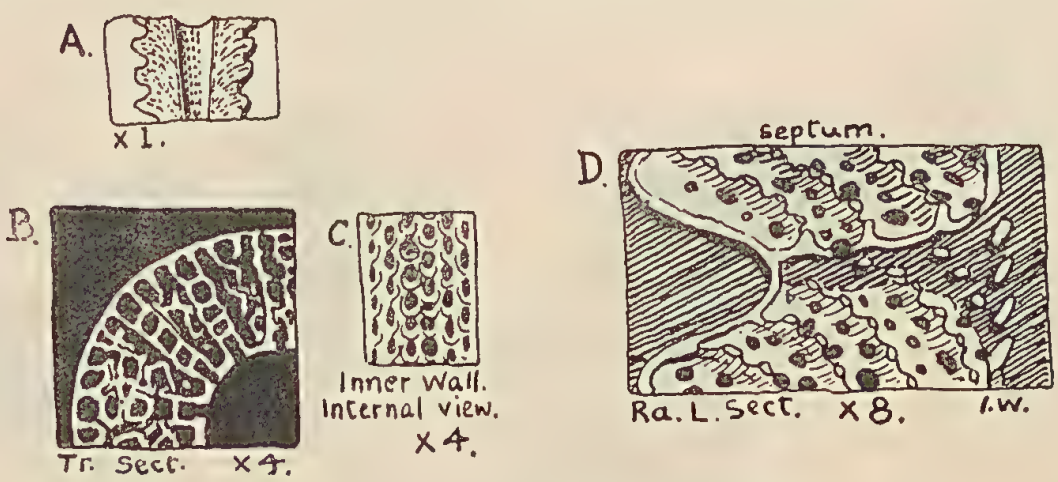
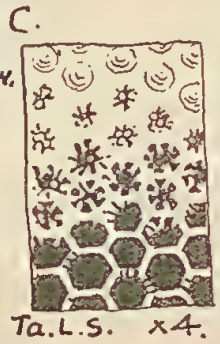


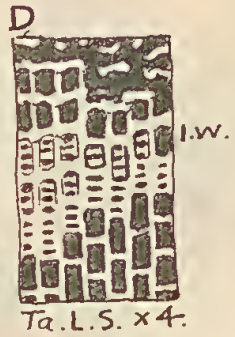
Fig. 73.

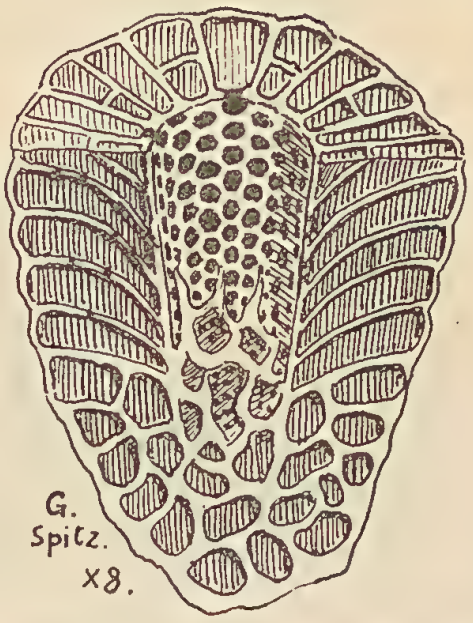


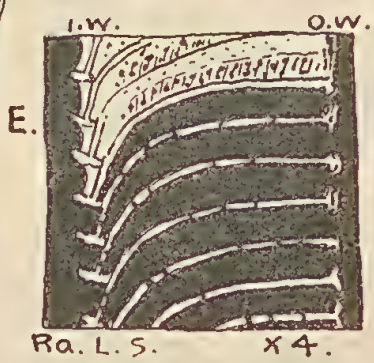
72. Pycnoidocyathus vicinisepta. 73. Pycnoidocyathus parvulus.

Fig. 74.









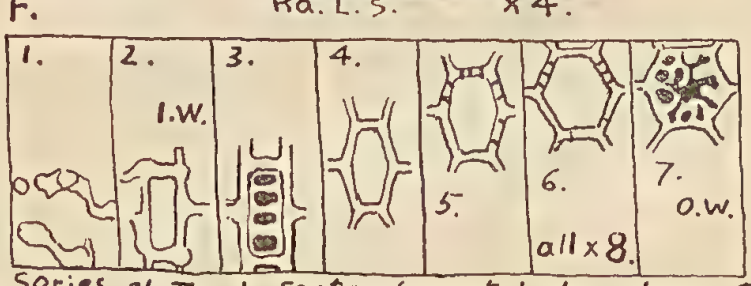
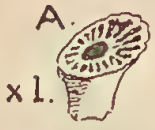
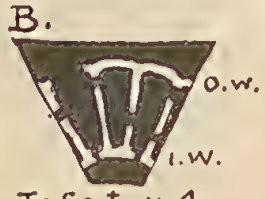
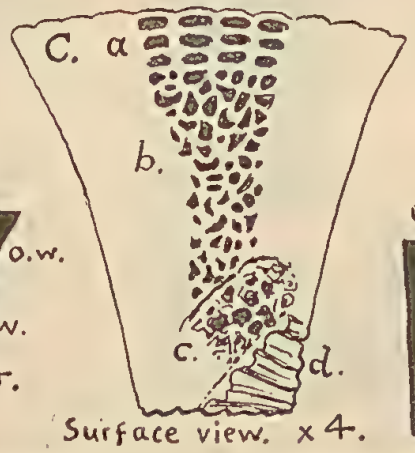


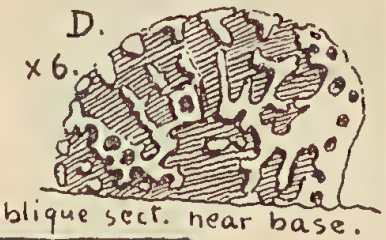
Fig. 75.

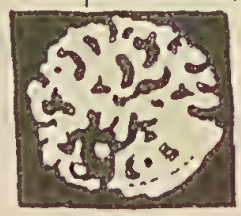
Fig. 76.











RB. '36.

74. Syringocnema favus. 75. Archaeopharetra typica. 76. Paracyathus parvus.

Fig. 77.

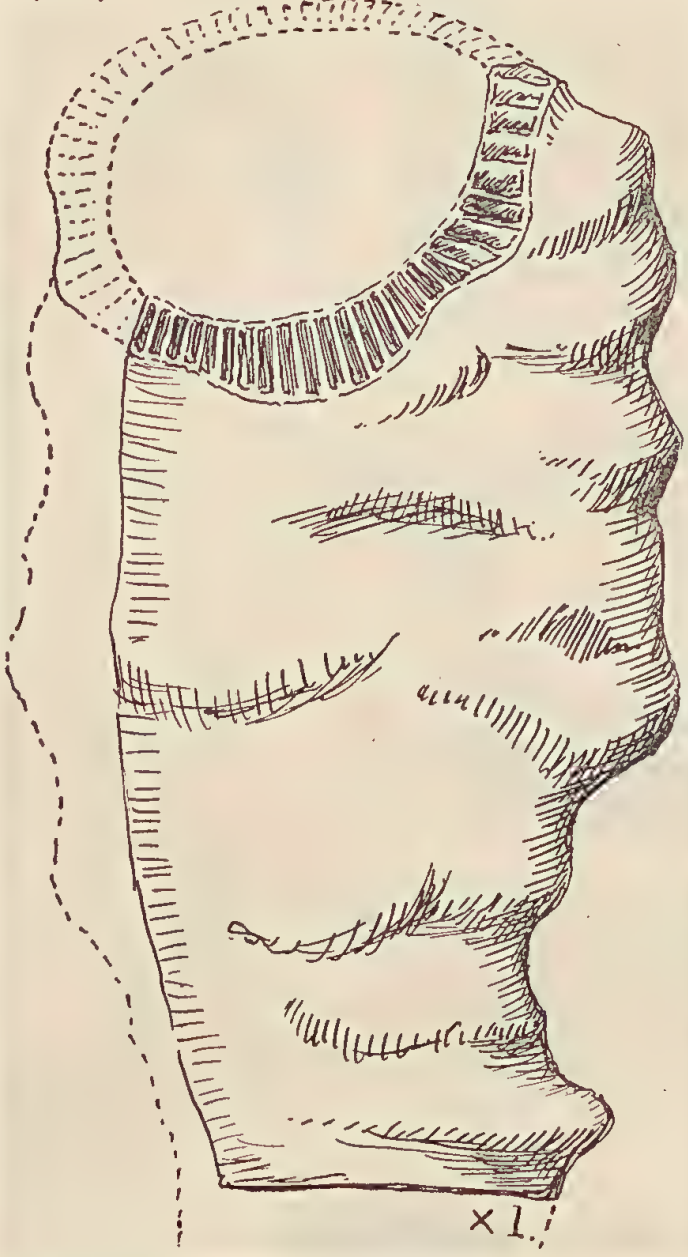
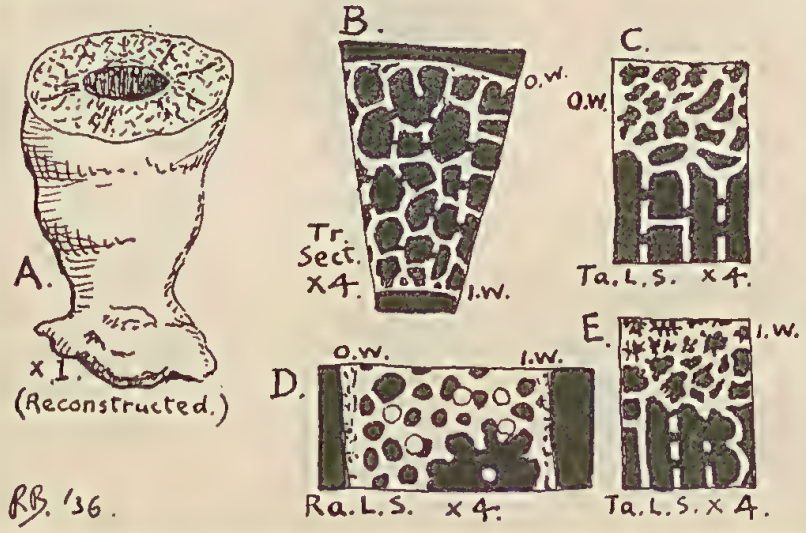


Fig. 78

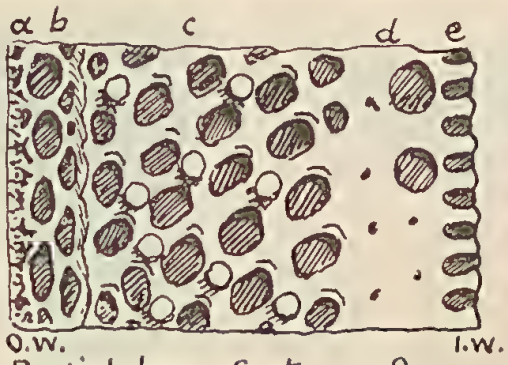
Fig. 80.

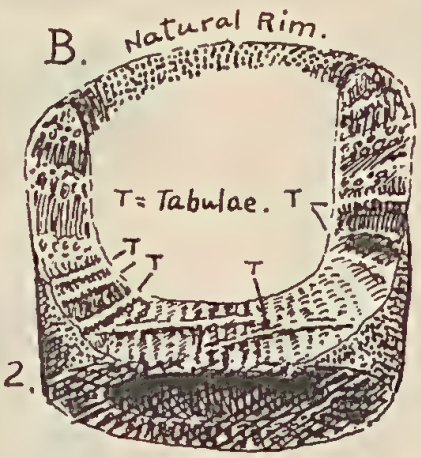
Fig. 79.

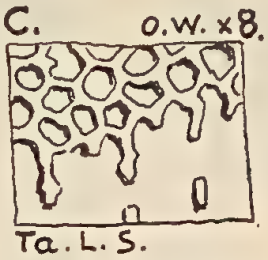


77. Metaldetes conicus. 78. Metaldetes superbus. 79. Metaldetes spiralis. 80. Metacyathus taylori.

Fig. 81.







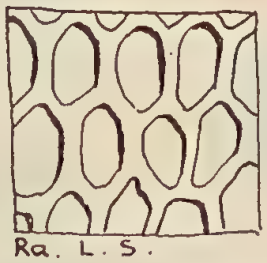


Fig. 83.

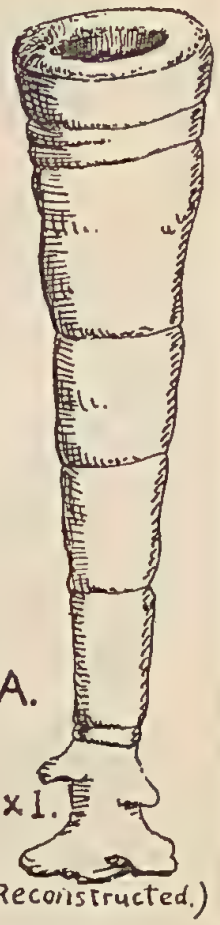
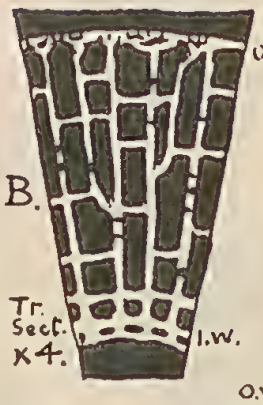
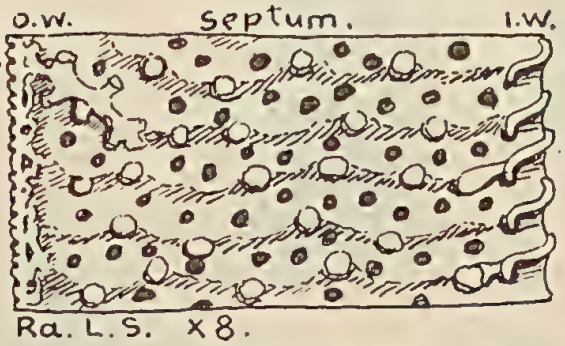
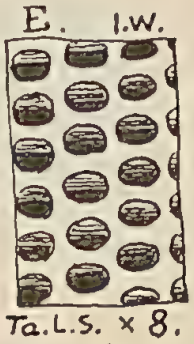
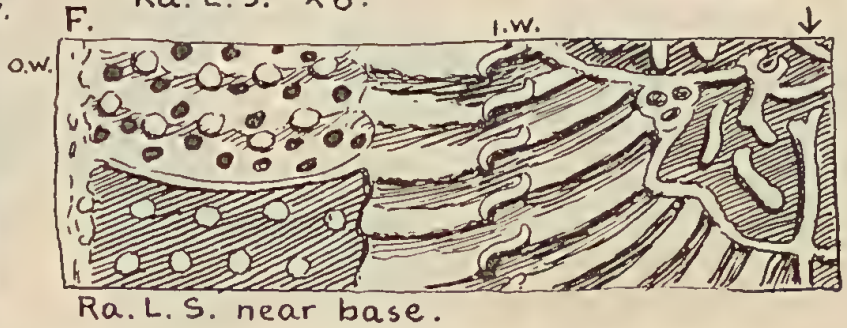


Fig. 82.









81. Metafungia reticulata. 82. Sigmofungia flindersi. 83. Metacoscinus reteseptatum.

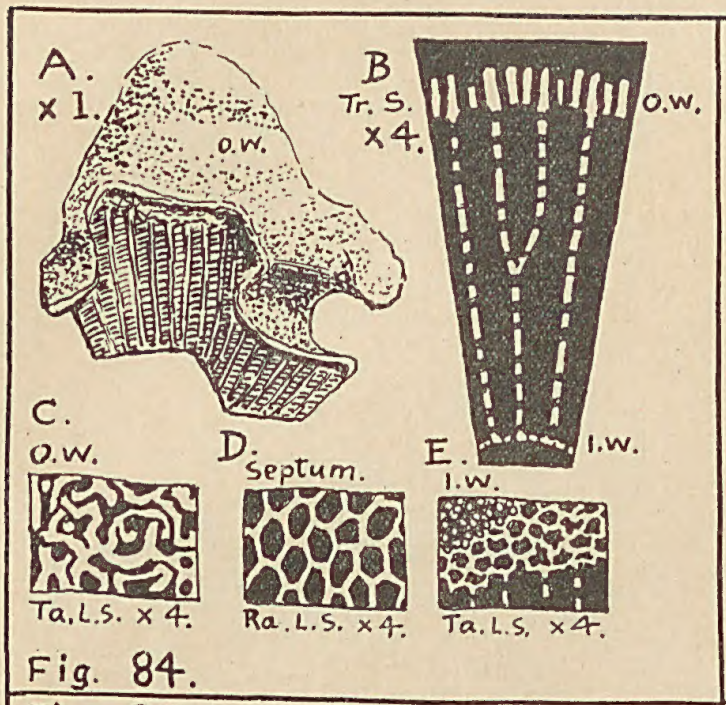


Fig. 84.

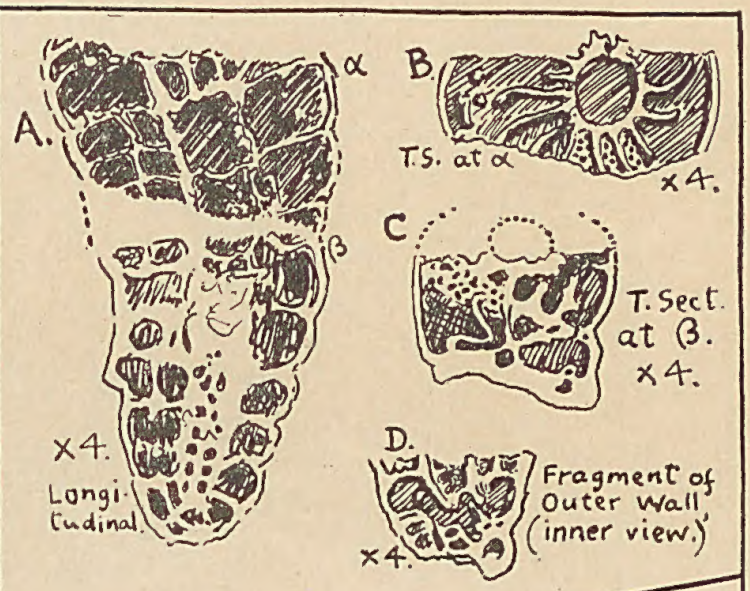


Fig. 86.

Fig. 85.

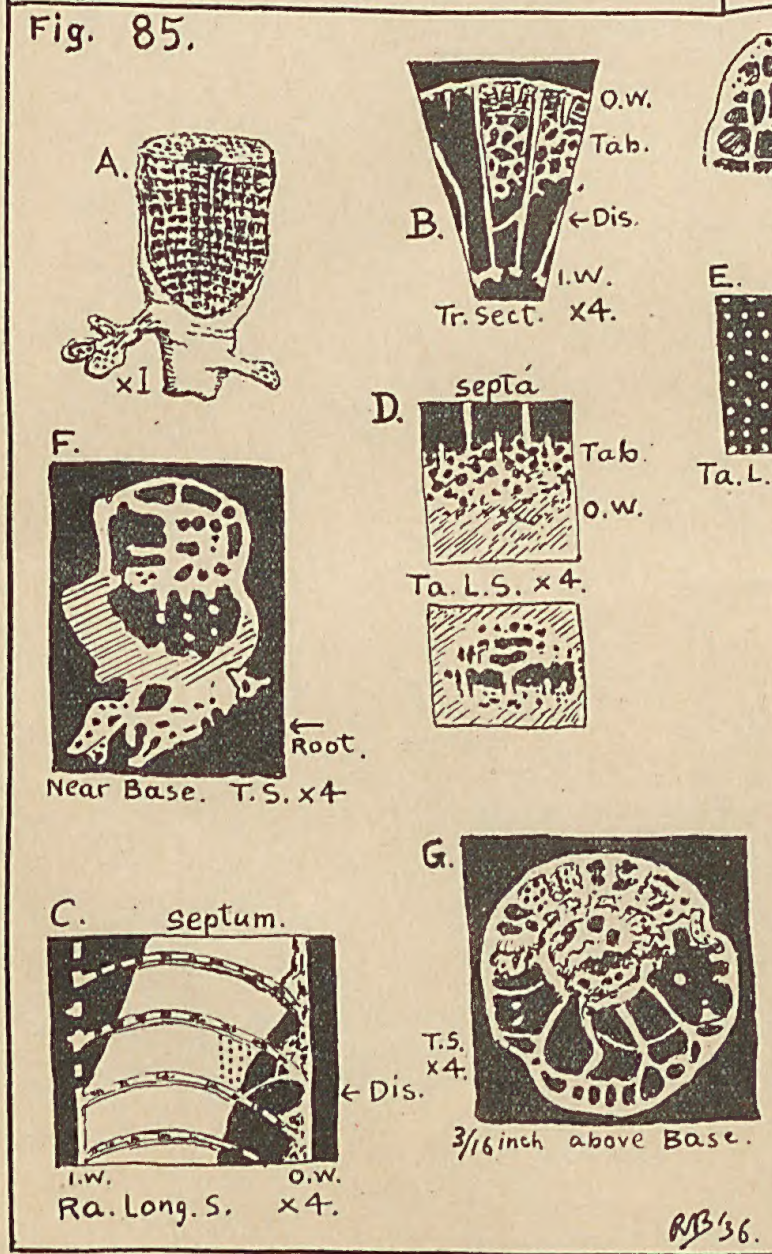
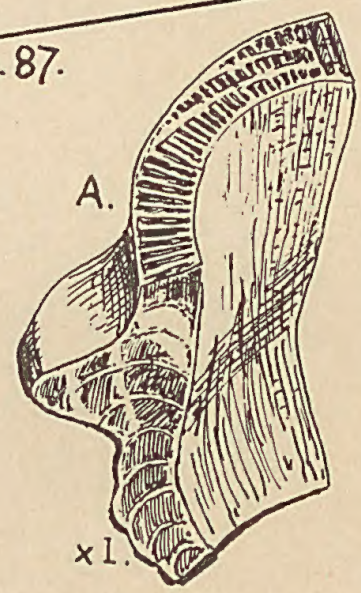
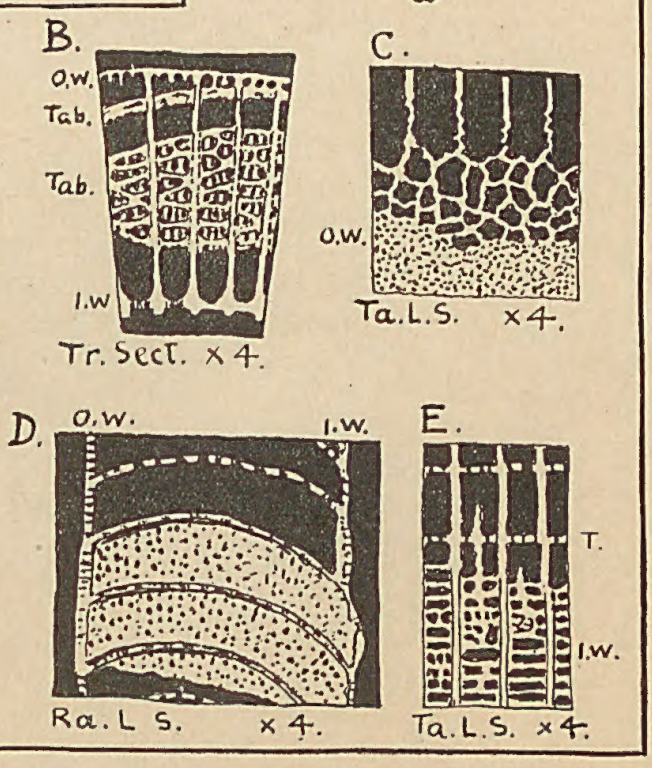


Fig. 87.





89. Metacoscinus insigne. 85, 86. Paracoscinus mirabile. 87. Pycnoidocoscinus pycnoideum.

MEMOIRS OF THE KYANCUTTA MUSEUM,

No. 1.—NEW SPECIES OF ARCHAEOCYATHINAE AND OTHER ORGANISMS from the Lower Cambrian of Beltana, South Australia. By R. and W. R. Bedford. March, 1934. (pp. 8 and 6 plates, 4to.) Price, post free, Two Shillings.

No. 2.—FURTHER NOTES ON ARCHAEOCYATHI (Cyathospongia) AND OTHER ORGANISMS from the Lower Cambrian of Beltana, South Australia. By R. and W. R. Bedford. April, 1936. (pp. 11 and 14 plates, 4to). Price, post free, Four Shillings.

The Kyancutta Museum has for Sale and Exchange Duplicate Specimens of ARCHAEOCYATHI. Also other Fossils, Meteorites, Mineralogical, Ethnological, and Zoological Specimens. Enquiries from Overseas Museums and Universities are invited.

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